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For cover story
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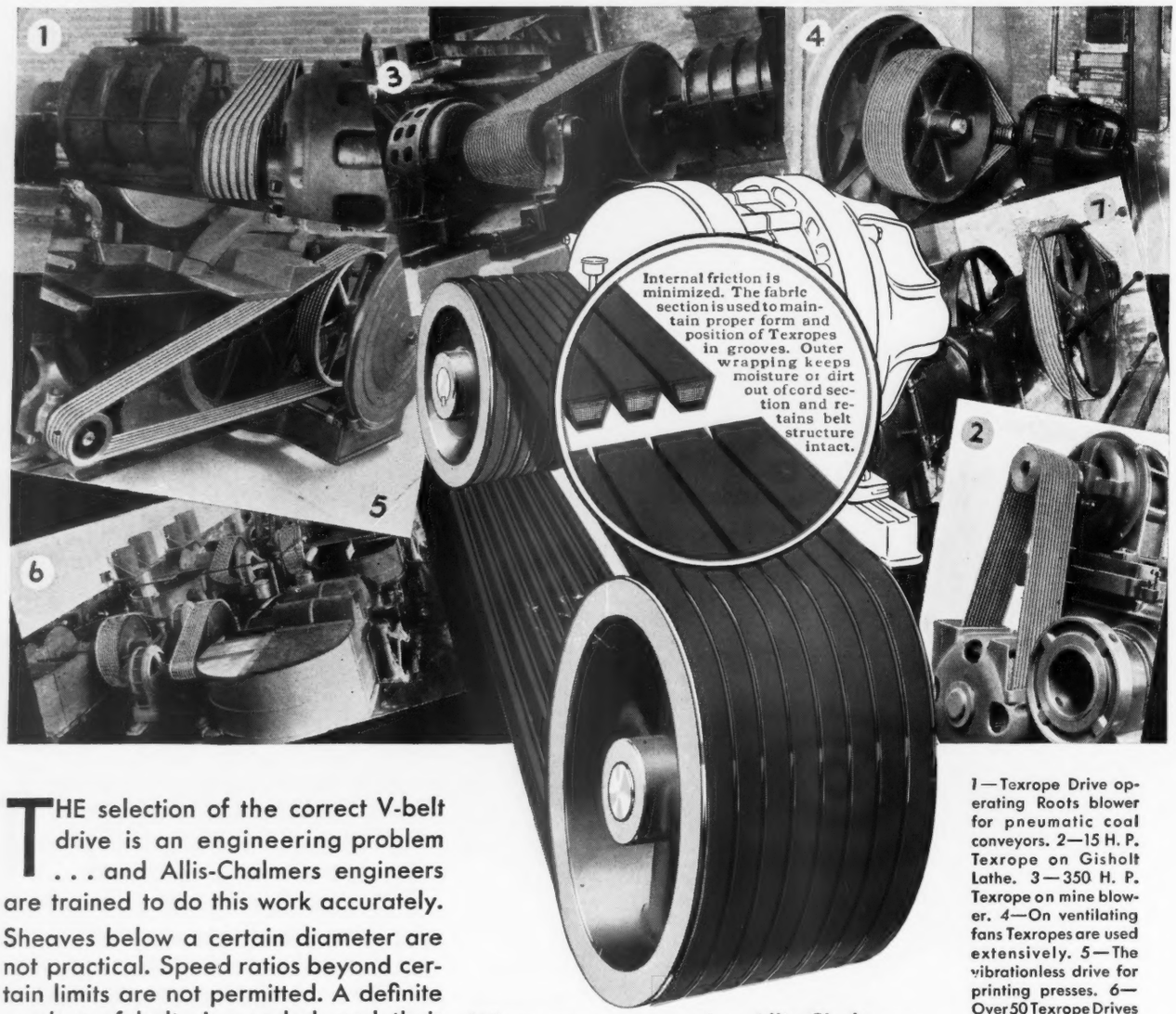
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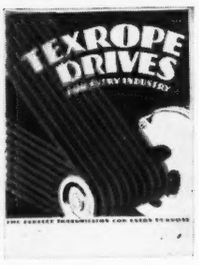

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Founded in 1882 as Electrical Review. Consolidated with it—Western Electrician and Industry Illustrated.

Maintenance Engineering in Plants, Mills, and Factories, as Applied to Electrical and Mechanical Equipment and Buildings

L. C. MORROW, *Editor*

Volume 88, Number 12

December, 1930

Feed Control in Bulk Handling 595
By G. R. BEST

New Bearings for Old 598
By W. B. MOORE

Editorials 602

Layout Reduces Lighting Bill 30 Per Cent 604
By RUDOLPH B. WEILER

Built-In Motor Protection 605
By G. R. ANDERSON

Plant Engineers' Forum 608

Lubricating Systems—Pressure Types 611
By FRED H. LOW

Around the Works 615

Bogies for Belting Buyers 617
By J. B. TOOMEY

We Know Our Maintenance Costs—and Here's Why ... 619
By A. G. WYNKOOP

Questions and Answers 623

Commutator Assembly Under Unfavorable Conditions ... 625
By E. J. MORRISSEY

Industrial Engineering's Data Sheets 631

Books 633

Equipment News and Trade Literature 634

No matter what the density, as long as it is bulk material, there is a system of control for feeding it in process. G. R. Best, page 595, describes manual, automatic, and vacuum-tube types used successfully.

If you have been afflicted with elusive maintenance costs, we have just what the doctor ordered. This prescription is free and you don't have to wait in line. Just turn to page 619.

And while we're on the subject of medicine—W. B. Moore forwards a plan for rejuvenating machines that are slipping economically. The story — "New Bearings for Old." The page—598.

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PUBLISHED MONTHLY
$2 PER YEAR
SINGLE COPY 25 CENTS

NEW YORK, *475 Tenth Avenue*
NEW YORK *District Office, 285 Madison Avenue*
WASHINGTON, *National Press Building*
PHILADELPHIA, *1600 Arch Street*
CLEVELAND, *Guardian Building*
ST. LOUIS, *Telephone Building*
SAN FRANCISCO, *883 Mission Street*
LOS ANGELES, *632 Chamber of Commerce Building*
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GREENVILLE, S. C., *1301 Woodside Building*
DETROIT, *2-257 General Motors Building*
LONDON, *6 Bouverie Street, London, E. C. 4*

Entered as second-class matter Feb. 25, 1929, at the postoffice at Chicago, Illinois, under Act of Congress of March 3, 1879. Printed in U. S. A.

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Maintenance Engineering in Plants, Mills, and Factories, as Applied to Electrical and Mechanical Equipment and Buildings

A McGraw-Hill Publication, founded 1882

Volume 88 CHICAGO, DECEMBER, 1930 *Number 12*

FEED CONTROL in Bulk Handling

By G. R. BEST

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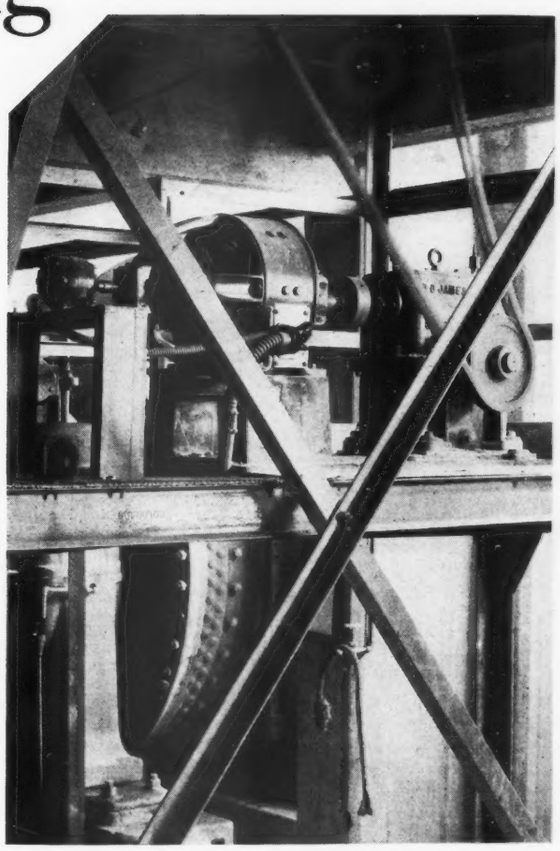
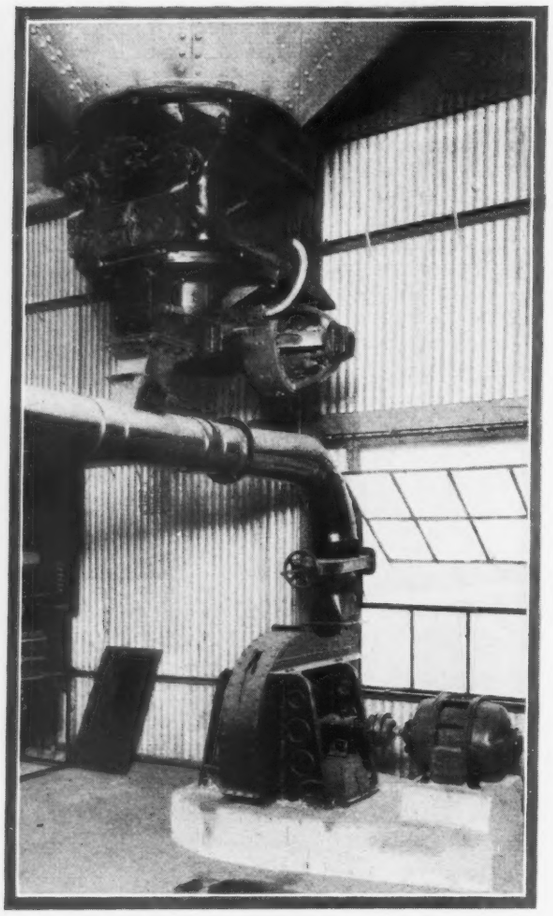
LOW cost is the desired result of a smooth-running factory process with machines operating steadily at their rated capacities. One problem confronting engineers in their endeavor to obtain low unit costs is that of maintaining the supply of material to process machines at a controlled and uniform rate. When this operation is accomplished the flow of material through the entire plant will be constant; all units will be enabled to operate at rated capacity, and the minimum of intermediate storage space will be required.

Problems of material feeding deserve careful consideration in the preparation of any factory layout. An advantageous solution contributes much to successful and economical operation, whereas one or two unsatisfactory feeder drives will prove a distinct handicap to an otherwise well-planned installation. Erratic material feeding results in inefficient operation of the machine in question, in that it causes variations in the product, and the fluctuating output of one unit is a serious disadvantage to the other machines to which the material progresses. Stalling loads and high peak loads impose unnecessary strains on mechanical and electrical equipment, resulting in high maintenance costs, and in the reduction of useful life of



One of four 5-hp. adjustable-speed d.c. motors operating four table feeders supplying controlled proportions of high- and low-content lime rock to two grinding mills. The electric tachometer generator coupled to the motor provides speed indication on the control panel shown on page 596.



Pulverized-coal feeding equipment supplying fuel to a cement kiln operates at a speed adjusted by the operator on the burning floor to maintain proper kiln temperature.

the machines. Fluctuating power requirements of a large unit may cause power system disturbances detrimental to the operation of the entire plant.

Accompanying illustrations emphasize some of the various means which are being used in the successful solution of feeder driving problems. On the basis of motive power feeder equipments may be divided into two groups; one including those feeders which are driven by individual electric motors, and the other made up of feeders driven mechanically by the machine to which the material is being fed, or as in some cases by the machine from which the material is received.

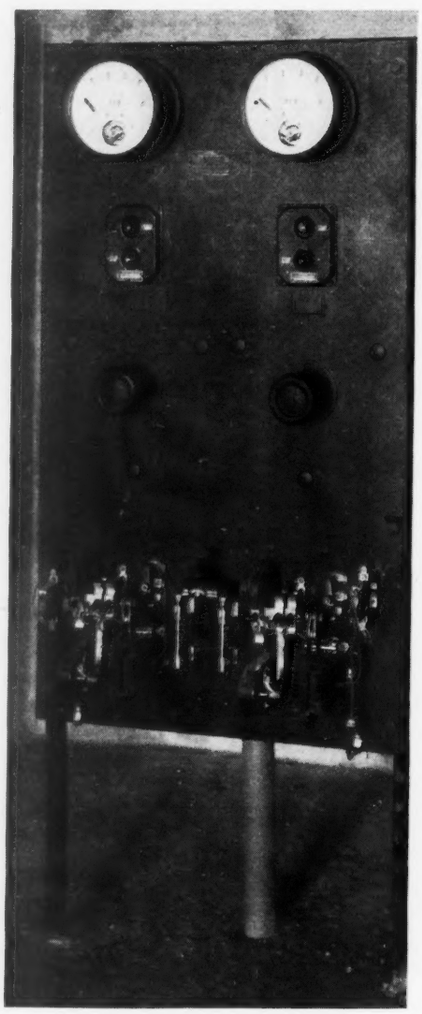
The first group or motor-driven type utilizes both constant and variable-speed motors, operating from either d.c. or a.c. power circuits, with various control equipments which enable the industrial engineer to meet exacting operating requirements.

In a cement plant a 15-hp. adjustable-varying-speed, wound-rotor induction motor drives a pan feeder through a speed reducer and a chain drive. This equipment supplies rock from a track hopper to a hammer mill. The motor speed and hence the rate of feeding are regulated from the central control station by an operator who also controls an electric car puller and car dumper as well as the motor-driven hammer mill and mill breaker plates.

The hammer mill operates at constant speed while the feeder-motor speed is adjusted by means of a drum-controller which varies the resistance in the rotor circuit to maintain the desired output of the mill. The hammer mill motor load is indicated by an ammeter in its power supply lines so that the operator need only adjust the position of the drum switch in response to power changes indicated to obtain uniform load on the crushing equipment, and a steady flow of crushed material to the conveyor which carries it to the pulverizing plant. Otherwise the mill motor load would fluctuate considerably and the delivery of crushed stone would be intermittent.

Processes which involve mixing different materials in proportions determined by their chemical analyses, require an accurately adjustable speed control on feeder drives, so that the finished product may conform to specifications which make no allowance for variation in the constituents of the raw material. Such processes are under the constant supervision of a chemist, who determines the relative amounts of materials used. One of four 5-hp. adjustable-speed d.c. motors whose controls are centralized for supervision, and a panel in which two controls are mounted, are shown in accompanying illustrations. These motors operate table feeders supplying high- and low-content lime rock to raw grinding mills in a cement plant. The rate of feed of each material is determined by the speed of rotation of its table feeder. Small d.c. generators coupled to the shafts of the feeder motors, as shown in the one view, are connected to the panel-mounted voltmeters whose scales are calibrated directly in r.p.m. of the table feeders, giving a continuous indication of the proportions of material supplied. Allowance is made for accurate adjustment of speed to compensate for changes in analysis of the raw materials by means of field rheostats whose hand wheels are located across the center of the panels.

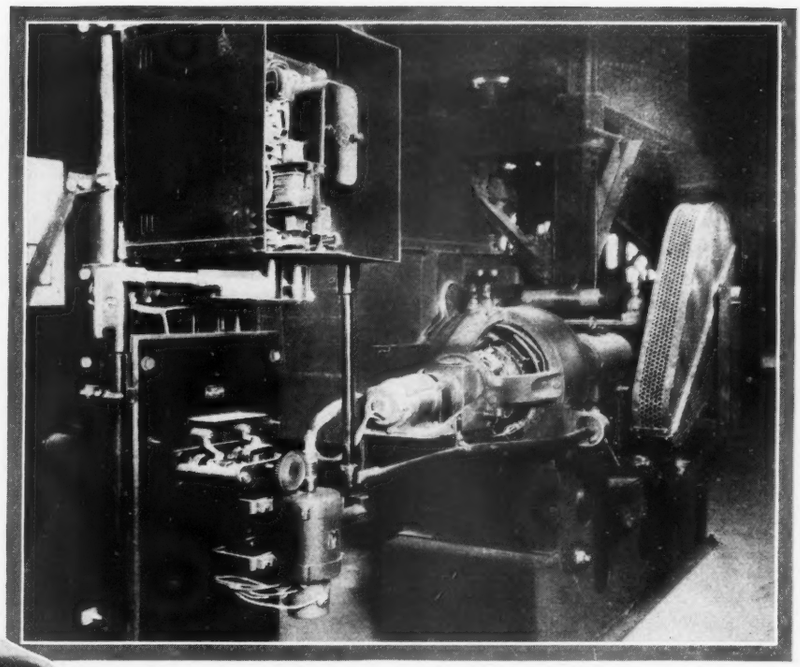
A pulverized-coal feeding equipment supplying air and powdered coal to a kiln is illustrated in another view. The primary air fan is driven by a 20-hp. constant-speed induction motor. Provision is made for the infrequent adjustment of air by means of



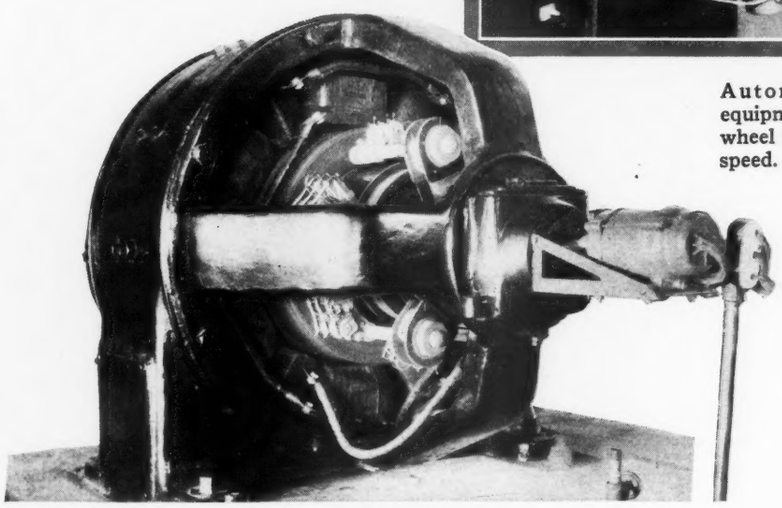
Control equipment for adjustable-speed, table-feeder drives, one of which is shown on page 595. The meters at the top of the panel indicate r.p.m. of the table feeders.

the valve in the fan outlet. The inverted 3-hp. adjustable-speed, d.c. motor is controlled from the burning floor, and drives the screw feeder at a speed, adjusted by the operator to maintain the desired temperature in the kiln.

"Selsyn" or self-synchronizing equipment is used to control the speed of a ferris-wheel slurry feeder in exact correspondence with the speed of the cement kiln to which the slurry is supplied. The system is illustrated by means of two accompanying views. The small machines coupled to the shafts of the kiln motor and feeder motor are "Selsyn" generators which are connected to a "Selsyn" differential motor that is shown mounted on the under-slung control panel. The differential motor operates a carbon-pile



Automatic "Selsyn" (self-synchronizing) control equipment used to maintain the speed of a ferris-wheel slurry feeder in exact correspondence with kiln speed. Adjustable speed d.c. motors are used.



Adjustable speed, d.c. kiln-driving motor with direct-coupled Selsyn generator which supplies pilot control for the above feeder-controlling equipment.

rheostat in the field circuit of the d.c. feeder motor, and remains stationary as long as the two generators are operating at the same electrical speed and phase relation.

Any tendency of either generator to lag behind or pull ahead of the other appears as a phase difference or angular displacement between them, causing the differential motor to produce a torque and to rotate in the proper direction to adjust the field rheostat of the feeder motor. Thus the motor speed is changed so that synchronism of the two generators is restored. The kiln speed is adjusted by the operator of the burning floor, and the slurry feeder at the opposite end of the kiln is automatically brought to the corresponding speed to deliver the proper amount of slurry to the kiln, assuring uniformly burned clinker.

Another kiln operating and feeding installation uses a single adjustable-speed d.c. motor to operate both the kiln and feeder, the feeder being driven by a synchronous motor which receives its power from an a.c. generator coupled to the kiln driving motor. This equipment also gives exact correspondence of feeder and kiln speeds under one control.

A feeder problem which required that materials be mixed according to weight was solved by use of the "Thyratron" or vacuum-tube control. The speed of one material conveyor is automatically adjusted according to the weight of material passing over a balanced section of the other conveyor, thus maintaining a proper proportion between the two materials. A weighing device attached to the balanced conveyor section operates the core of a solenoid or variable reactor, changing the reactance and consequently shifting the phase angle of the thyratron grid voltage. The thyratron tubes supply field excitation to the controlled conveyor motor. Their output, and, therefore, the conveyor speed automatically responds to the weight of material passing over the controlling conveyor thereby maintaining a uniform ratio of materials.

Other automatic electric-relay equipments are used in some installations to control the feeder motor in response to load on the driving motor of a process machine. Some of these raise and lower the feeder motor speed in inverse proportion to the main motor load, while others stop the feeder when the main motor load reaches a predetermined maximum, and restarting the feeder when the load has decreased to the proper value.

A considerable number of processes do not require adjustable-speed control on feeder drives. These drives are usually equipped with squirrel-cage, constant-speed induction motors which require only a very simple control equipment, and provides a low-cost installation.

The second general group of feed-

ers is made up of those which are driven mechanically by a process machine.

Many coal pulverizing mills are equipped with a mechanical feeding device which is driven by a belt and gear equipment from the shaft of the main mill motor. The driven pulley and shaft on the feeder run at constant speed. The supply of coal delivered being controlled by a ratchet and pawl device which alternately engages and releases the coal-feeding mechanism to maintain a uniform density of the mixture of air and powdered coal delivered by the mill. The pawls are operated by a control system which uses U-tubes to measure the density of the mill output, and releases or engages the pawls to correct any deviation from the desired density.

In this group are secondary rock crushers equipped with an apron feeder which is chain-driven at constant speed by the primary crusher.

In the foregoing examples of motor-operated and mechanically driven feeders only a few of the many schemes and devices employed in successful bulk-material feeding installations have been discussed. Most of them are derived from the cement industry, wherein service requires rugged and dependable equipment, and a controlled process manufacturing a uniform product to rigid specifications. They may readily be modified to meet a variety of operating requirements. Electric control systems for feeders, conveyors, and process machines frequently offer opportunities for improved process control with appreciable reductions in operating personnel.

NEW BEARINGS for OLD

By W. B. MOORE
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Canton, Ohio

Does it pay to replace plain with anti-friction bearings? How do the job?

MANY machines that are slipping economically and practically can be rejuvenated by replacing their plain bearings with anti-friction bearings. Such bearings are not a panacea for every mechanical evil. But, granted that the other factors in the case are as they should be, the advantages to be derived from a bearing changeover, *if it is properly done,* are thoroughly worth consideration. Bearing changeovers are not to be hastily conceived, nor carelessly made; if a few simple basic rules are observed there is no reason why they should not be successful. No set of rules for procedure should be taken too literally; the variables are entirely too numerous.

The most important phase of any bearing changeover is accurate load determination. Ninety per cent of all bearing failures come from pernicious over-loading or, to put it differently, from under-estimated normal loads.

It would seem that the obvious source of load information would be the manufacturers of the machine in question and, up to a point, that is true. But, to such information should be added data obtained, either by observation or by test, concerning the actual conditions under which the machine is working. There are many purely local circumstances that can change load characteristics and volumes considerably, sometimes almost beyond recognition. Temperature conditions can alter load pressures or introduce strains, either by causing shaft expansion, or by producing other maladjustments unforeseen by the builder. Or, speed may be increased, which naturally alters load characteristics. Or the character of the material upon which the machine is working may change. In the case of steel rolling mills, for example, the steel being rolled has a decided influence on the bearing loads.

There are simple but effective means of determining load characteristics. As an instance, if the machine happens to be driven by an electric

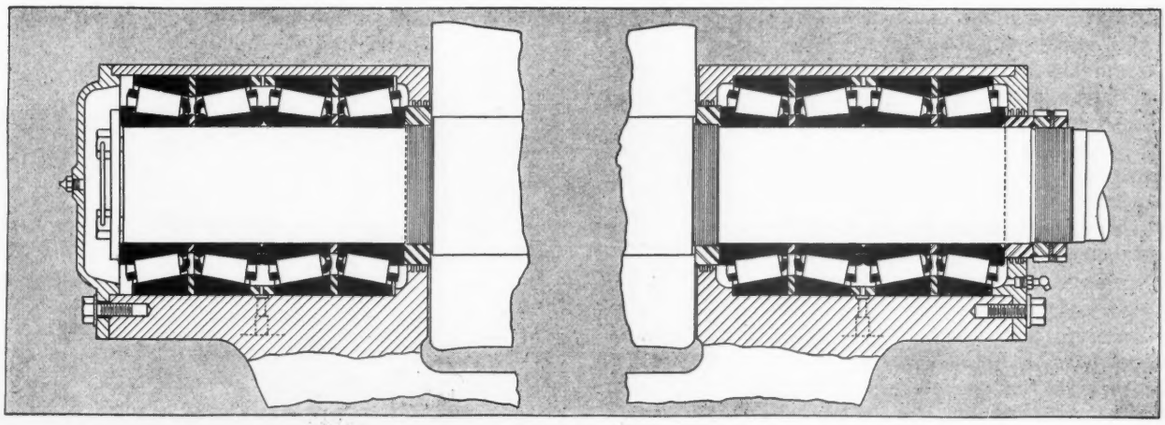
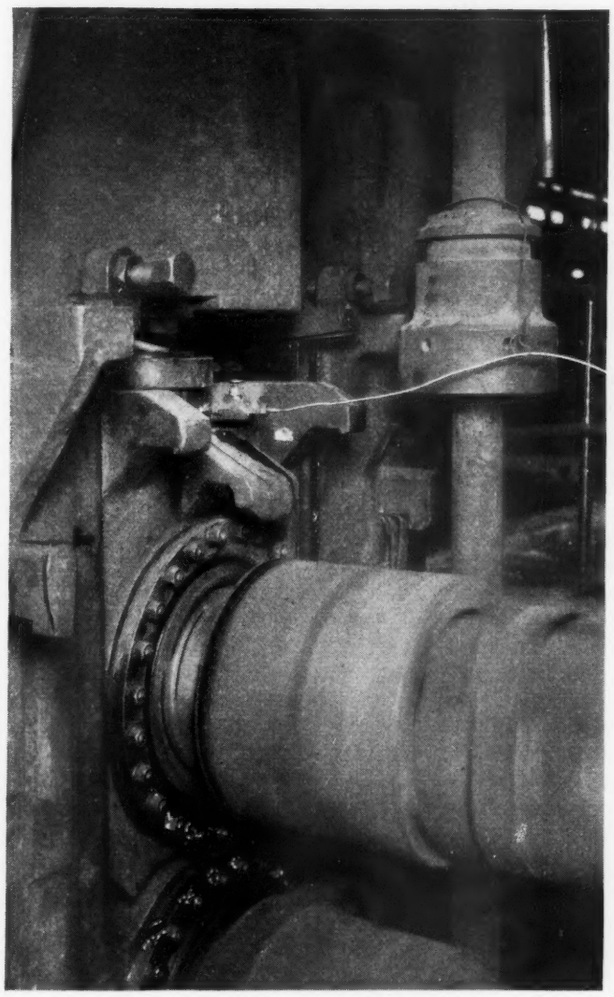


Fig. 1. Section of roll straightener roll shaft on which anti-friction bearings were mounted in the original plain-bearing housings. The housings were bored to the required diameter and the new bearings mounted in the usual way.



Hydraulic cylinder in bearing block of steel rolling mill during tests made to determine load pressures on bearings. The connection to the recording pressure gage is plainly visible.

motor, curve-drawing instruments in the motor lines will give an excellent idea of load characteristics. Information concerning the duration of peak loads is just as important as a preliminary to bearing selection as that concerning their volume. The ideal method is one that will give both, showing the relation between the two. Such a method exists; it has been particularly successful in the case of the heavy-duty equipment, such as rolling mills, rubber mills or brick machines. It probably could be applied in principle to numerous lighter machines. It is simple and accurate and furnishes a permanent record.

The apparatus consists of a hydraulic cylinder placed in the machine to be tested at the point where the loads are to be measured, and connected to a recording pressure gage which can be calibrated to read directly in pounds pressure. The rather common beliefs (a) that shaft size is determined alone by the loads to be carried, and (b) that any bearing which fits the shaft will of necessity have sufficient capacity to carry the load are misleading. One of the dangers of this theory is its plausibility, and another is the fact that it leaves so much unsaid. For instance, it makes no provision for possible thrust loads, which are no less destructive because they are unsuspected. And there is also a conspicuous silence concerning such matters as possible impact loads, shaft expansion, speed or acceleration characteristics, and other factors that may affect the selection of bearings. As a theory it is all right as far as it goes, but in most cases it does not go far enough to be relied upon.

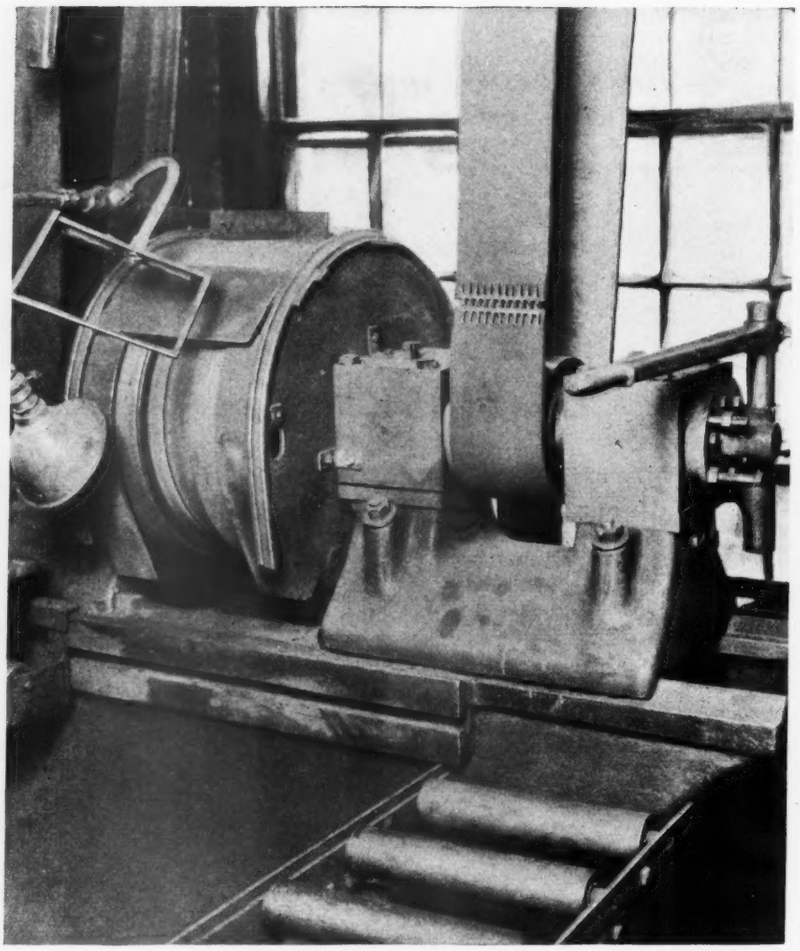
Once the bearings are properly selected as regards capacity, there remain several questions regarding mounting. Certain general rules have been formulated by bearing engineers. Where the rules do not seem to fit, or are difficult to follow, it is always better to consult the engineers rather than to take chances. Basic mounting practices are fairly uniform. For example, in dead shaft, low-speed applications, the inner races usually are given a light fit on the shaft, and the outer races are pressed tightly into the housings. As the speeds increase good practice usually calls for fitting the inner races more tightly on the shaft, or for adopting some method of preventing their rotation. This may be accomplished by press fitting, or by keying, depending largely on the type of bearing used. The former practice is adequate in most cases.

In the case of rotating shafts procedure is practically reversed. At low to medium speeds the inner races usually are given a press fit on the

shaft, and the outer races a light fit in the housing. At higher speeds it is customary to increase the tightness with which the inner race is fitted. In the case of heavy-duty machines, and in those where loads are unusually severe, both races should be given press fits too tight to be loosened by any hammering action to which they may be subjected. Creeping action of either race, in short, should be eliminated when the duty is heavy, in order to prolong the life of both supported and supporting parts. The matter of dead or live shafts also makes some difference in the arrangement used to locate the bearings; that is, to fix them in the proper axial position. Generally speaking, in the former case the bearings are located through the inner race, and in the latter through the outer.

If it is a matter of applying tapered roller bearings there is one factor to be considered that does not arise with any other type. This is the comparative merit of what are known as the direct and indirect methods of mounting. Mounting stability of this type of bearing requires that one bearing always be opposed by a mating bearing. In the former, the bearings are mounted with the larger ends of the rollers facing each other, while in the latter the smaller ends are facing. The choice between the two mountings depends primarily on the load and speed characteristics of the installation, although other factors also may exert some influence. For example, direct mounting is recommended where bearing centers are comparatively far apart, where speeds are above 1,000 r.p.m., and on live-shaft applications generally. The indirect mounting is to be preferred where centers are relatively close, where speeds are 1,000 r.p.m. or less, and where shafts are stationary. It is always to be preferred where thrust loads are especially heavy, regardless of speeds and live or dead shaft conditions. A typical example is overhung gears or pulleys.

The question of thrust loads is of importance. There is not room for much discussion where the extreme in either direction is concerned; it is the happy medium that causes most of the disagreement. If the load is practically all radial, the bearing selection problem is fairly easy to settle. The same holds true where it is either all thrust, or where the thrust component greatly overbalances the radial. In such cases the only logical solution is the installation of a type of bearing especially designed for thrust loads. But, where the two loads exist together and are nearly equal, the problem is not so simple.



A disk grinder converted from plain to anti-friction bearings. New housings have been made and mounted on the original pedestals, which were planed down to the proper dimensions.

The next matters of importance in changing over bearings are those of housings and closures. With regard to the former, other things being equal, housing design is one of the most important factors. The principal difficulty arises from the fact that with plain bearings capacity is a function of the length, while in an anti-friction bearing it is, in nearly all types, a function of the cross section, or rather of overall diameter. As a consequence it is seldom possible to put anti-friction bearings where plain ones were without radical changes in the housing construction. On the other hand, installation is not necessarily unduly complicated; some sort of compromise usually can be evolved that will be perfectly satisfactory in practice. For example, it is sometimes possible to provide an effective mounting by simply machining the original housings to a point where the bearings can be fitted directly into them. This has been done in the mounting shown in Fig. 1, which is the roll of a straightening machine. The original split-type housings have been machined to take the new bearings, which are mounted very much along conventional lines. It will be noted that the assembly at one end is permitted to float, while the other is fixed. This is a common and useful precaution, as it compensates effectively for any inaccuracies in machining.

Another method of mounting new bearings in old housings may be classed, for the sake of brevity, as the cartridge method. In this type the bearings are assembled in cartridges and the whole is mounted as a unit in the housings, which are bored to receive them. Such a mounting is shown in Fig. 2, which is a screw-machine spindle. In this case, the cups have been pressed into the cartridges and the cones are given a light fit on the shaft, so that the whole

mounting can be assembled as a unit. It can be seen that the cartridge assembly at one end is firmly locked in place by a flange on the cartridge that bears against a shoulder machined in the housing, the two being pushed together by a flange on the outer closure. The cartridge at the other end is permitted to float in the housing, for reasons already explained. Both cartridges are keyed to prevent rotation in the housing, and the assemblies at each end are separately located by means of split nuts.

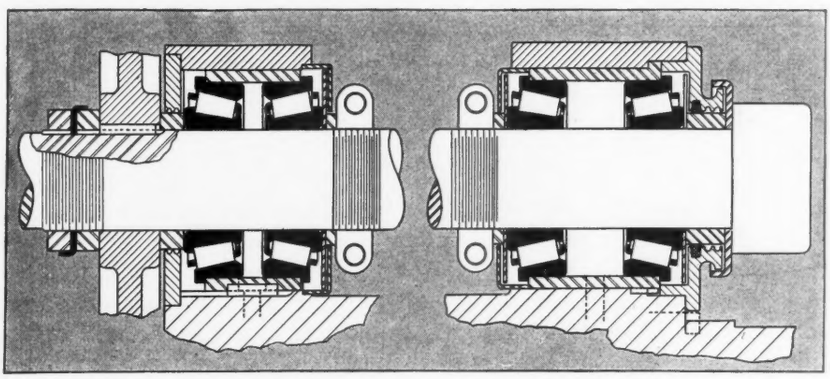


Fig. 2. Section of screw machine spindle mounting employing cartridges for the anti-friction bearing. The method of preventing rotation of the cartridges, and of locking at one end are plainly visible.

Irrespective of which method of mounting is used, the observation of a few simple precautions will add considerably to final effectiveness. For one thing, extreme care should be used in boring the housings, to assure concentricity. The best practice is to use jigs or fixtures that will permit boring both housings simultaneously so that any errors in general dimensions will be compensated for automatically. As may have been gathered from the two examples given, it is good practice to fix one mounting and allow the other to float. This arrangement completes the compensation for discrepancies in machining. When cartridges are used, some means should be adopted to prevent them from rotating. The most common, which has been shown in Fig. 2, is to key them in place. Another, which is especially effective in large machines, whose duty cycles include heavy shock loads, or where there is considerable vibration, is to babbitt them in. In this method grooves are cut in the cartridge that correspond to lands in the housing, or vice versa. The housing bore is made large enough to leave an appreciable space around the cartridge and the assembly is set up so that the space is even all around. Babbitt is then poured into the housing. This method has been used in the mounting shown in Fig. 3.

There remains the problem of machines in which, for various reasons, it is impracticable to use old housings. In such cases it is equally impracticable to do more than barely suggest methods of mounting because of the inevitably wide variation in the circumstances of individual cases. Usually the solution involves the construction of entirely new housings, which are put on the machine in the easiest way possible. One case where this was done has interesting features, partly because of the comparative simplicty of the construction adopted, and partly because of its cheapness. The case consisted of several disk grinders that it was found desirable to change over to anti-friction bearings. It was found that the original housing could not be used. Therefore, the pedestals were planed off to a point below the level of the old housings, and square steel boxes were mounted on the planed surfaces. The bearings were mounted in brass cartridges, which in turn were mounted in the new housings, and keyed to prevent rotation. The two cartridges on one side of the machine float in the housings, so that the abrasive wheel can be moved back and forth, while the two on the other side are fixed. The results of the mounting have been entirely satisfactory for over a year of service.

Finally, there is the matter of closures. There are about as many types of closures as there are bearing applications, so that the latitude of choice is exceptionally wide. Grease is, generally, the preferred lubricant. Therefore, anti-friction bearing closures as a rule can be simple, but it should be remembered that grease is applied under pressure and that the closure should be designed accordingly. There is one common rule that is fairly safe to go by: closure design is governed by the consistency of the lubricant used, and by the speed of operation.

Changing bearings in existing machines need have no terrors for the careful. Experience has proved that practical and economical improvements can be the result.

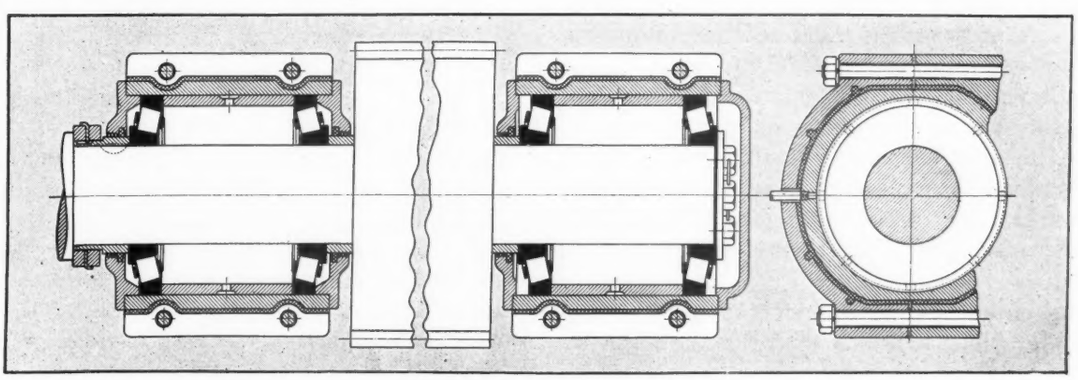


Fig. 3. Section of the shaft on a heavy-duty machine on which the bearings are mounted in cartridges and the cartridge babbitted in place to prevent rotation.

INDUSTRIAL ENGINEERING

L. C. MORROW, *Editor*

Vol. 88 DECEMBER, 1930 No. 12

More Net Profit—It Can Be Had Now

WE venture a prediction. It is that after the nervous perspiration of 1930 has evaporated, and we look back at the year's net results, one thing will be clear: That the manufacturers who came through in the best condition were those who bought net profits in the form of savings in operating costs made possible by modern equipment.

When industry is booming along operating expenses climb. Extra personnel is added and inefficient equipment is tolerated because there is no time for replacement. Substantial net profits take the limelight, and objectionable conditions are in shadow.

But as sales decrease net profit becomes smaller and the objectionable conditions emerge from the shadow. Prices are reduced in an attempt to maintain sales, the reductions being made at the expense of net profit. Thus the shortcomings of plant operation are subjected to greater exposure.

Equipment that is wasteful when times are good is a greater deterrent during depression because its waste is greater in proportion to net profit. Production suffers from products of low quality, with many rejects and lack of uniformity. Plant operation suffers from high maintenance costs and the use of excessive floor space. These drawbacks modern equipment eliminates.

The accepted signs point to 1931 as a year of building up toward 1929 or 1928 levels. When those levels are reached there will be no willing tolerance for replacement. Every plant will want to keep on going. However, there will be enforced shutdowns for replacement, for repair, and for installation, by those plants too shortsighted to insure the future now. These plants will be suffering from ill winds that will be blowing substantial profits to their farsighted competitors.

There is nothing particularly sage in these statements. It is obvious that the time for investment in plant equipment is when prices are low and time is plentiful. Buying futures it is, to be sure, but it is also buying immediate net profits, because of the relative importance of low cost of plant operation.

The plant man responsible for uninterrupted production and for economical plant operation not only has the opportunity—it is his duty—to present to management recommendations for equipment and methods that cannot be denied because of their effect upon net profits.

When Equipment Gets a Vacation

TAKING a motor, transformer, cable, or other piece of electrical equipment out of service for a few weeks or months is not simply a matter of pulling a switch or two. It is well for those who have occasion to put equipment on the idle list to remember that frequently it will deteriorate faster when idle than when in service. When windings are cold moisture penetrates them more readily, paving the way for corrosion and inevitably resulting in loss of strength that may lead to early failure. Outwardly the winding may appear to be in good condition, but when it is again subjected to the searching test of service the hidden weak spots show up and a trip to the repair shop results.

Before electrical apparatus goes on a vacation it is highly advisable to give it a thorough cleaning, check the condition of bearings and other mechanical parts, and apply an insulation-resistance test to the windings. If this test shows up satisfactorily, the machine should be protected against moisture and dust while it is idle.

The next step is to make periodical tests of the insulation, in order to detect promptly any weaknesses that may develop. The cost of such care is trifling in both time and money, but it may save expensive repairs and gives assurance that the equipment is ready for immediate service when needed.

A Tip for Industrial Gamblers

A MANUFACTURER gambles when he designs new products. To be sure, the placing of his stakes is based upon analyses: of future demands; of trends in style and taste; of choice of fabric or color; of the possibility of increased productivity. But after all there is no guaranty that the analyses are correct. Be the product a new tooth paste or a new automobile its future is a gamble.

That's a narrow viewpoint—admitted. Seems far-fetched to involve the invention, initiative, and enterprise of manufacture in such a definition. And so it is. But it's not more foolish

than the attitude implied by some of the manufacturers themselves toward plant modernization and rehabilitation during this period of depression.

If new products can be brought out and successfully marketed upon the analyses of future demand, trend, or absorption, why can't plants be re-outfitted upon the simple analysis that they again will become very busy, just as they always have become busy after a depression?

They can. And some of them are. More should be. If this bit of gambling—though there is no risk to justify the term—is gotten out of the way now, the background is at once prepared for the later gambling with designing and marketing.

Maybe You Can Buy Replacement Parts Cheaper

PRICES for replacement parts many times seem all out of proportion—in the eyes of the user. But the manufacturer says, "They have to be high—I'm not making enough profit on them now."

He's right, for the most part. Replacement orders call for small lots. Just as much paper work is required as for big lots; orders must be recorded, process and shipping instructions issued, machine set-ups made, follow-up carried on, and shipment made. If the parts are for obsolete equipment special tools may be required. And of course the user has to pay.

For instance: a manufacturer of electrical control equipment found that his replacement orders constituted a certain proportion of his total of orders. Yet in volume of work going through the plant they were only one-third as much, and prices had to be correspondingly high. It happened that the steel industry was responsible for most of this replacement business, so that the manufacturer had opportunity for definite analysis of what was what.

He found in one mill, for example, that it was customary for the individual departments to place orders for single replacement parts, irrespective of the requirements of other departments and of their own future needs, in order not to have large maintenance charges placed against them during any one month of operation. Perhaps each of six departments would place an order for one of the same part during a given month, yet at such times the manufacturer was forced to put them through the plant as six orders.

This manufacturer was able to induce the steel plant to budget its replacement requirements over a longer period, and to arrange for co-operative ordering among the departments. The arrangement resulted in fewer but larger orders, which were put through the plant in lots large enough to give a fair profit even though sold at a much lower figure than the customer had been paying.

It doesn't appear logical that the coffee shop should order beans today, the mezzanine restaurant order beans tomorrow, and the main dining room place its order for beans on the next day. If all are going to serve beans let the beans be bought for all on a single order with the advantage of a big-order price, since all three are working to make a profit for the hotel.

Beans are not replacement parts, but there doesn't seem to be anything the matter with the analogy. Budgeting beans, or control parts, or any other replacement parts—what's the difference? The main idea is that departments ought to co-operate and plants as a whole to budget their replacement parts.

From Oil Can to Sheepskin

TIME was when lubricating oil was regarded as something to be purchased for the lowest possible price, and its application left to the discretion of whoever happened to have the oil can. These carefree customs may seem ludicrous when compared with the procedure in many modern plants, although there are still some shops where they would fail to excite comment. In any event, in the old-time plant speeds were much lower than is customary today, bearings were usually of liberal design, and operating conditions in general were much less severe and exacting than now.

Today, great progress in the refining of oils and production of lubricants, development of new types of bearings and bearing metals, and the discovery of many fundamental facts concerning lubrication have all conspired to take the lubrication problem out of the hands of day laborers and place it in the hands of the lubrication engineer, where it belongs. Many plants have found that it pays to put the responsibility for the proper lubrication of all equipment on one man who has had sound technical training and thorough practical experience. Given the necessary authority and support, he should be held strictly accountable for results—and if he is worth his salt the chances are that he can show something very tangible.

Finding the lubricant and method of application that will enable a bearing to give the maximum service with the minimum amount of trouble and waste of power is not easy. It is a job for none other than a specialist.

Layout Reduces Lighting Bill 30 Per Cent

By RUDOLPH B. WEILER
Mechanical Engineer
Jefferis and Weiler
West Chester, Pa.

QUALITY as well as the quantity of work in a printing plant is directly influenced by the kind and the amount of light available. Consequently, when plans for the new printing plant of Horace F. Temple, West Chester, Pa., were under way, proper lighting and power distribution were deciding factors in the final layout.

To make the fullest possible use of natural lighting, steel sash was used the entire length of the building and monitor. For night work, the lighting system described herewith was designed.

A study of the local power company's schedule disclosed that a very favorable rate could be obtained if all energy was taken at 220 volts, 60 cycle, three phase. This was done in the following manner: Six rows of lamps, 10 ft. apart, were run down the entire length of the building which is 65x185 ft. including the office section. The lamps were spaced 10 ft. apart, the second and fifth rows being staggered with respect to the first and sixth. This gave the shop 16 outlets on the second and fifth rows and 15 on each of the other rows. The two center rows, being split in the middle, were divided into four circuits. Each of these four circuits is three phase, the lights being equally balanced between the phases and controlled by four three-pole snap switches on the center-post panel. These lamps illuminate the center aisle, which is almost clear of machinery.

All lights in the remaining four rows are fed three phase from the end and are controlled by individual pull switches. This type of switch was selected because all of the machinery in the plant is located under the four end rows but all of it is not used at night. Therefore, it is possible to turn on only as many lamps as are needed to illuminate the units in operation. This arrangement also gives a balanced three-phase load on the lighting circuit.

To operate the electric refrigerator, the electric clock, and office equipment such as adding machines, etc., a 110-volt circuit was run from a 2-kva. 220/110-volt transformer placed across one phase. This also supplies current for six pilot lights operated from three-way switches and six convenient outlets for portable electric tools.

Lamps of 220 watt rating in 16-in. R.L.M. reflectors placed 11 ft. from the floor and averaging two watts per sq. ft. are used throughout the shop. Note the absence of shadows in the accompanying photograph. Also notice the uniformity of illumination as shown by the parabolas on the rattan screens in front of the windows. These screens are used to cut down the direct rays of the sun.

All overhead conduits are used; the machines being fed down from the ceiling. This was done to avoid the necessity of putting conduit under the concrete floor and to facilitate the wiring of new machines or changes in the present arrangement. The galvanized conduit coming down to the machines is hardly visible against the light gray finish of the walls and steel work.

A 30-percent reduction in the light and power bill under that of the old plant was reported in spite of the fact that additional machinery was installed and production was increased in the new plant.

The layout which reduced the lighting bill 30 per cent.

Operation dependent upon ventilation, which governs rating—designing to limit size and cost

BUILT-IN MOTOR PROTECTION

Fig. 1—Air intake and exhaust are piped to the outside with this motor in which the fan or blower used is mounted integral with the motor.

By G. R. ANDERSON
Chief Engineer
Fairbanks, Morse & Company
Beloit, Wis.

IN the preceding article (November issue), discussion was confined to certain types of motors wherein the protection provided was in the form of inpregnated windings and protective covers. Particular attention will now be paid to the inclosed ventilated types.

Inclosed-Ventilated Motors

Because of the rapidly rising cost characteristic of the totally inclosed motor, as illustrated by the curve in the previous article, the designers were naturally led to develop other types of inclosed or protected motors in which forced ventilation is used. One of the motors of this type resulting therefrom is the inclosed ventilated motor shown in Fig. 1. This motor is one designed to be protected from the dust, dirt, and fumes of its surroundings, and ventilated by clean air piped from a suitable supply. The fan or blower used for circulating the cooling air through the motor is usually mounted integral with the motor.

Equally satisfactory results can also be obtained by an external blower. The exhaust air can be emitted direct from the motor or away from the motor through suitable ducts as desired. In many cases satisfactory operation can be obtained by the installation of air filters on the intake side eliminating the intake pipes. This of course depends on the severity of dust conditions surrounding the drive.

Most motors of this type consist of the manufacturers' standard open motor equipped with a special frame-casing fan. The size to which motors of the type can be built is limited chiefly by mechanical considerations. The turbo-alternator, for instance, can be considered as an inclosed ventilated machine of this type equipped with external blowers and other means for keeping the cooling air

free from dust and injurious elements.

Although the temperature rise guarantee of inclosed-ventilated motors is usually the same as standard open motors, the overall efficiency is slightly less owing to the extra large fan or blower that is required. The cost, however, does not vary with the size as in the totally inclosed motors, but has a constant value of approximately 40 per cent higher than the standard open motor. Where clean air is readily available or the use of filters permissible this motor will find favor where protection is required.

Inclosed Fan-Cooled Motor

Another type of inclosed motor that has been developed and which has become popular during the past few years is the inclosed fan-cooled motor illustrated in Fig. 2. This motor is actually a development of the totally inclosed and inclosed ventilated motor in that it combines features of each. It consists essentially of two casings, an inner casing that incloses the windings and vital parts of the motor and acts as a radiating surface for the heat, and an outer casing that direct the cooling air supplied by a fan mounted external to the inner casing.

This motor, however, presents new problems in design and many interesting methods have been devised for their solution. The first problem naturally concerns the radiation of heat through the inner casing. This function has been successfully accomplished by the use of thin-walled, heat-conducting shields or by corrugating the surfaces and thereby increasing the area to a value sufficient to obtain the desired temperatures.

It should be remembered, however, that a motor of this type is essentially a totally inclosed motor and the measurement of temperature is an important item. In this case, also, measurement by thermometers, even though imbedded directly in the coils or core, is subject to error unless precautions are taken. The flow of cooling air between the two casings passes around the exposed part of the thermometer and causes an erroneous reading.

Differences as much as seven or eight degrees in imbedded thermometer readings have been noted when the thermometer extensions have been insulated from the blast of cooling air passing around it.

In the case of the inclosed, fan-cooled motor there are even more arguments in favor of resistance measurements for temperature than in the case of other types.

Limitations in size of the inclosed, fan-cooled motor follow along the same characteristics as the totally inclosed motor. Most designs up to 30 or 40 hp. can successfully use standard, open-type stators and rotors. In the larger ratings, however, the cost and size mounts very rapidly in proportion to the open motor.

Its advantages lie in the fact that in the smaller and medium sizes it is a self-contained motor not much larger than the corresponding open motor and considerably smaller than the totally inclosed motor. Inclosed-ventilated and inclosed, fan-cooled motors are not usually built in ratings below 2 hp. for, in sizes smaller than this they have no economical advantage over the totally inclosed motor.

Lately, a uniform agreement has been reached whereby 55 deg. C. has been adopted as the standard temperature guarantee to be given inclosed fan-cooled motors. Undoubtedly, the actual temperature rise of the majority of the smaller ratings come well under the specified guarantee while the larger ratings will more closely approach it.

Incidentally, there will be wide differences in temperatures of motors of the same rating built from different designs. It is generally agreed, however, that reliability and long life of insulation go hand in hand with low

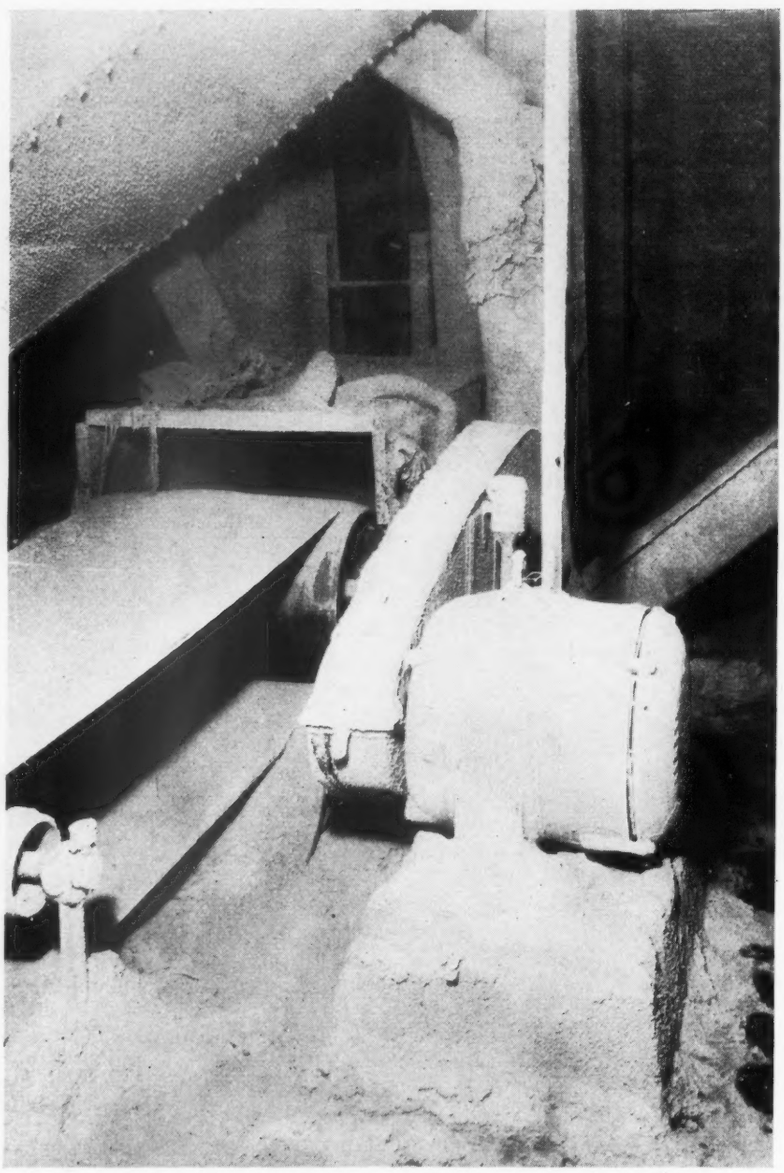


Fig. 2—An inclosed, fan-cooled motor in which an inner casing incloses the winding and other vital parts and acts as a radiating surface for an outer casing that directs the cooling air supplied by a fan mounted external to the inner casing.

temperatures, and it is obvious, therefore, that careful consideration should be given to this factor in applying the inclosed, fan-cooled motor.

Inclosed Squirrel-cage Motors

The problem of cooling inclosed motors concerns itself just as much in the elimination of hot spots in the motor as in getting an overall satisfactory temperature.

One of the most recent developments in the field of inclosed motors of the squirrel-cage type has resulted in temperatures almost as low as corresponding open motors. This latest type is illustrated in Figs. 3 and 4.

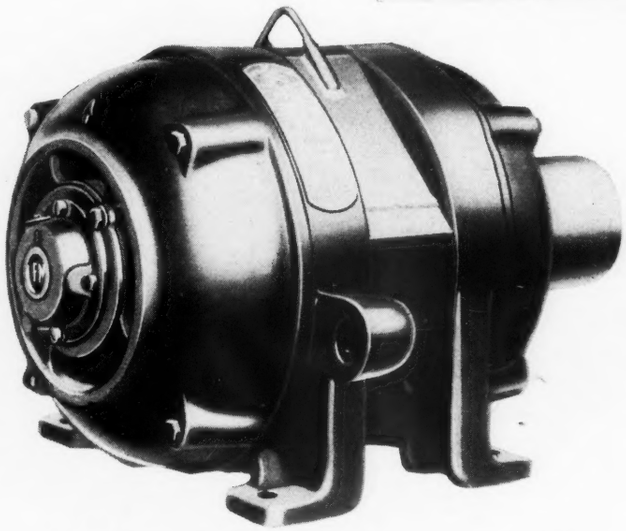


Fig. 3—An inclosed squirrel-cage motor with inclosing shields to protect the stator windings and air gap.

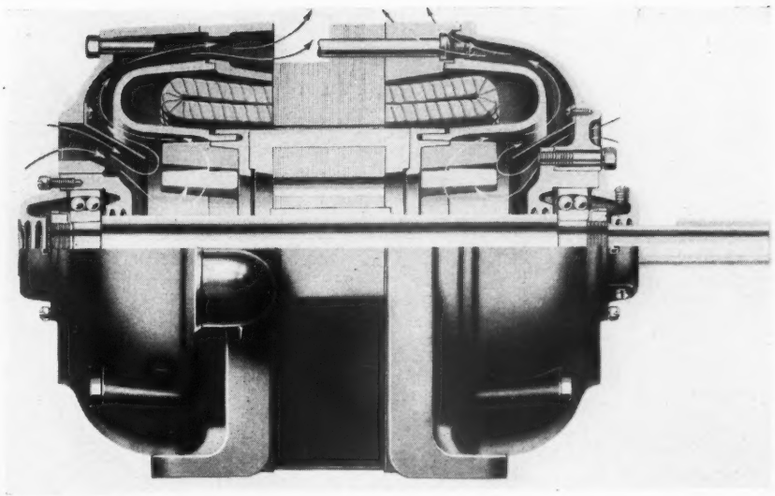


Fig. 4—Skeleton view of the motor shown in Fig. 3. The inclosing shields are exposed to the cooling action of the air which is forced over them as indicated by the arrows.

In a squirrel-cage induction motor, the rotor in itself requires no protection from dust, dirt, iron filings, etc., since there is no insulation on this member. It is desirable, however, to give full protection to the stator windings and air gap. In addition, if the rotor and rotor windings are exposed to the cooling air, there is an almost direct path for the transfer of heat through this highly conductive winding to the surrounding air.

It is almost a general rule that when the rotor runs cool the rest of the motor will likewise run cool. It is a good axiom for designers to follow. As a result of inclosing only the stator windings and air gap and exposing the rotor, the transfer of heat from the motor is almost as good as if the motor were entirely open. The table shows the results of heating tests conducted on this type of motor, with inclosing shields and built open type.

15-Hp., 1,800 R.P.M., Three-Phase, 60-Cycle, 220-Volt Inclosed Motor

	Temp. Rise
Fan-cooled	50 deg. C.
Same motor built with inclosing shields	28 deg. C.
Same motor built open type	24 deg. C.

The seal between rotor and winding shields may be a simple close clearance or it may be a more intricate labyrinth seal depending upon the degree of protection required. The dimensions of a motor of this type are not necessarily any greater than that of a standard open motor. It is obvious that the two may be designed to take practically identical parts except the shields and thereby have exactly the same dimensions. The limitations of size are not pronounced as in the case of totally-inclosed and inclosed, fan-cooled motors while the ratio of cost to that of the open motor should be fairly constant.

Motors much larger in rating than that economically feasible with totally inclosed or inclosed, fan-cooled construction have been built with very satisfactory results. In fact, it is considered entirely practical to design motors of this type to have a 40-deg. C. temperature guarantee as compared with the 55-deg. C. guarantee given on totally inclosed and inclosed, fan-cooled motors. The effect of the lower temperature should tend to prolong the life of the motor, provide greater reliability and increased service, which after all are the chief functions of the inclosed motor designed for applications where the conditions of dust and dirt are severe.

Play Safe When Using Oxygen

IT is important to remember that pure oxygen under pressure is an active substance. It will cause oily and greasy materials to burst into flame with almost explosive violence. Take all precautions to keep oil and grease away from cylinders, regulators, and other welding equipment.

Never use oxygen to impose head pressure on a tank and, never confuse oxygen with compressed air.

PLANT • ENGINEERS' • FORUM

* * *

NO HOME WORK THIS MONTH —that is, no new question. All of the pages of the department are given over to discussions of questions presented in earlier issues. We'll clean up as well as possible by publishing as many as we can of the discussions already received that we may start the forum with a clean slate next month in the first issue of the new year.

* * *

Shall There Be a National Association of Maintenance Engineers?

(Question presented in the November issue)

I BELIEVE that the formation of an association of maintenance engineers should be supported as a means of exchanging ideas and information and the forwarding of the collective and individual skill and technical knowledge of the maintenance engineer. There exists a community of interest which frankly has been allowed to lie dormant too long. Despite the fact that the maintenance engineer is closely allied to the particular industry in which he functions, there is a far greater basic tie between maintenance engineers regardless of industry. There are problems of equipment, materials, and organization which can be best solved by the pooling of all existing knowledge. Ideas which may seem peculiar to one type of organization will, upon minute inspection, be found applicable in their general terms to the work of all maintenance engineers.

I however, feel that the creation of such a national organization should not be developed as an independent venture, but should be fostered as a special divisional activity of an existing national engineering society. The creation of a national engineering society is a tremendous undertaking in organization, and requires an energy in mere formulation which should be avoided if at all possible. A functioning national society requires a trained, paid staff and a tradition of service among its members that is the result of years of gradual and painstaking growth.

One of the existing national engineering societies, such as the A.S.M.E. might well foster this as a special group activity. The S.A.E. has shown that this is a highly feasible way of fostering special activities, and even goes so far as to hold national production meetings.

As most of the maintenance engineers are probably at present affiliated with one of the existing national societies, this is a service that the society which holds the greatest number among its members might well render. This will not only aid the parent society in increasing its membership, but it will give the maintenance engineers a ready-made organization and all the machinery necessary to get right down to the roots of their problems. This is particularly valuable, as any one who has been a member of a local engineering group with national aspirations will appreciate the many almost unsurmountable difficulties that beset such an ambition.

Such a special grouping of the interests of the maintenance engineers is not only desirable for the obvious and direct benefits attainable, but also for the educational value of acquainting all engineers and executives with the general problems and responsibilities of the maintenance engineer. Here is a group that has suffered both directly and indirectly for want of a medium of collective expression. Few people outside the profession itself really appreciate the problems and responsibilities of this very significant group of engineers. They should, by all means, seek some form of national organization as a means of developing and unifying their interests, as well as broadening their technical knowledge and creating a valuable class consciousness.

CHARLES E. KIRKBRIDE, *Project Engineer*
Naval Aircraft Factory, United States Navy Yard
Philadelphia, Pa.

I CANNOT see where there would be any material advantage to the men in this line of work by forming an association, because existing engineering associations are always bringing up subjects that are intertwined with maintenance, and the meetings and the minutes of such are published.

I believe that there is more to be gained by the reading of columns such as the one in this periodical and

other publications on mechanical subjects. I take this stand from experience on a problem of like latitude; there have been started, movements to form an association of time-study men, but it has been proved that there would be no advantage; for example, the Boston Chapter of the S.I.E. invites the time-study men in this district to its meetings where men, well versed in the subject, lecture. Is it not better to hitch on behind the bigger organizations that get the leaders in industry for lecturers? If an organization were formed, what transpired at the meetings would be known only to those able to attend. For them to publish a magazine containing the grist of the meeting would be an expensive undertaking, and unnecessary, because the market is flooded with periodicals carrying on this work in a thoroughly efficient manner. I can get more up-to-date information in my line by reading these periodicals and attending the S.I.E. meetings than I could in any other way.

I am afraid that to form such an organization would be a hindrance to these men rather than a help, because they would be standing on their own feet, with the result that publications which are doing such excellent work for them would feel obliged to step aside as far as this particular subject is concerned, something which I hope will never happen, as in my opinion, there are many more interested persons reached under the existing conditions.

CHARLES R. WHITEHOUSE, *Standards Engineer*
The Holtzer-Cabot Electric Company
Boston, Mass.

TO form a National Association of Maintenance Engineers would bring about a repetition and an overlapping of certain features which we are now obtaining from our affiliations with the existing engineering societies.

We have within our national societies many professional sub-divisions which give us practically all the advantages we could expect to derive from a new society, especially for engineers devoted to the plant maintenance field.

Within engineers' clubs and local sections of a major engineering society, we have discussions and exchanges of ideas which have worked out in our own plants and in those of other members.

Furthermore, in our relationship with our major societies, i.e., the A.S.M.E., A.I.E.E. and the Am. Soc. C. E., we become acquainted with the newest and latest ideas and developments in the respective fields of engineering. Is it then necessary or feasible to burden ourselves with another organization, which in itself, cannot help being a repetition of certain phases of those with which we are already connected?

We come in contact with many broadening influences and practical ideas at the regular meetings and special sessions of our local engineering society, which comprises all the major society local branches. We should like very much to devote more time to them than we do now, but find this impossible owing to other necessary diversions. By forming another association we would find ourselves with less time for these meetings. This would result in the benefits now derived being lessened due to the neophyte organization taking up our time to repeat ideas which can be, and are, secured from present sources.

The thought may be expressed that a National Association of Maintenance Engineers will give us a means of assembling all ideas which will directly benefit us, casting aside those which seem irrelevant. It is evident that we do this at present by enrolling in the professional subdivisions of our engineering associations.

The formation of a National Association of Maintenance Engineers would merely give us another organization in which to enroll, pay dues, and reap a slight benefit.

E. M. DETWILER, *Plant Engineer*
Worthington Pump and Machinery Corporation
Buffalo, N. Y.

E. M. DETWILER

Plant Engineer, Buffalo Works of the Worthington Pump and Machinery Corporation, Buffalo, N. Y., doubts the value of a National Association of Maintenance Engineers, the subject discussed by George and Frank last month. His contribution starts in the preceding column.

BY all means, a national association, because it will prove to be of great benefit to the maintenance engineer and to the plant that employs him. The dissemination of information vital to the development of the maintenance profession can be accomplished only through the formation of an association of this character. It has been proved that industry as a whole has advanced in direct proportion to the extent of the interchange of ideas and information concerning plant practices.

Through the formation of an association of this type, maintenance engineers throughout the country will have an opportunity to gain new ideas about their line of work. Contact with men pursuing similar work will tend to stimulate the members, and show them how to tackle problems similar to the ones which are being solved every day. Ultimately, a maintenance association should include the three sections: electrical, mechanical, and building maintenance.

HARRY KAUFMAN, *Engineering Department*
Naval Aircraft Factory
Philadelphia, Pa.

THERE is a possible field for an Association of Maintenance Engineers which would yield rich returns if properly cultivated. The avenue of approach would be to work with the existing societies, such as electricals, mechanicals, civils, chemicals, iron and steel, and testing of materials, and bring the particular problems of maintenance to the attention of the specialists. To take a page from the book of the modern research laboratory, we may say that the quickest returns may be secured from group study by a large number of specialists. Therefore the problem of the association would be one of co-ordination of existing facilities.

The creed of such an association should be: The prevention of failures of equipment, materials, and

men; the solution of the underlying cause of failures which occur; the regimentation of new methods, materials and personnel training for the quickest possible restoration of defective equipment.

I believe that *Industrial Engineering* amply fills the position as the official publication of the association outlined, and furthermore, that the readers are already members.

J. Elmer Housley, *Electrical Superintendent*
Aluminum Company of America
Alcoa, Tenn.

I BELIEVE a National Association of Maintenance Engineers would be beneficial to the engineers themselves and to the industry as a whole. I think that such an organization is entirely possible, but should be an independent venture, and not a part of any other organization.

The best place for a man to get new ideas is at a convention, where papers are read by other engineers describing improvements made in their own plants. Then, if an exhibit is held in connection with the convention, the latest devices are shown; the engineers can see them and, if they approve, recommend purchase to their own companies.

J. Walter Wright, *Asst. to the President*
Wilmot Fleming Iron & Steel Company
Philadelphia, Pa.

Who Shall Specify Equipment?

(Question presented in the October issue)

FRANK had a kick coming in, "Who Shall Specify Equipment?" To this question, like all others, there are two sides, for equipment such as machinery and repair parts, the purchasing agent should have nothing to say as to what kind to order. He should obtain prices, catalogs, delivery dates, etc., for the man who is to do the ordering.

Most men in charge of machinery want the very best material for its operation, even though there may be several "very best" articles available at varying prices. For economic and efficient operation it is a sound policy to have frequent consultations between the purchasing agent and the man who does the ordering.

M. B. Kramer, *Chief Engineer*
El Paso Milling Company, Ltd.
El Paso, Texas

SPECIFYING factory equipment can cause much confusion and ill feeling in any plant unless definite rules are established.

Both plant engineer and purchasing agent are usually men of considerable experience in their respective lines and each transaction should be arranged, if possible, to take full advantage of this fact. It is obvious that the engineering department is in closer touch with factory conditions and knows more about the actual operation of the various machines than the purchasing department. On the other hand, the purchasing agent is in closer touch with market conditions through his daily contact with salesmen and other factory representatives, and is usually well posted on all of the latest developments in each class of equipment used.

The solution of the problem appears to be to let the plant engineer draw up complete specifications of the equipment needed, but to leave the actual placing of the order completely in the hands of the purchasing agent without limiting him as to the specific brand or make.

For example, a motor is required to drive a certain pump in the factory. The plant engineer should specify size, voltage, speed, and type of winding of the motor required. He should also specify special features and whether the motor is to be furnished with plain or ball bearings, and so on.

Such specifications will allow the purchasing agent considerable leeway in the purchase of the motor as it will usually be found that several large manufacturers can supply equipment that will meet the specifications. In this way competitive prices can be obtained. This general method will be found adaptable when handling requisitions for almost any type of equipment except, in the few instances, where some special type of machine is required that can be obtained from only one concern.

These methods can be applied to factory supplies as well as to equipment, always keeping in mind that the engineering department should endeavor to draw up their specifications in such a manner that the purchasing department will not be limited to one brand or source of supply. The plant engineer should know the grades of oil, types of packing, and so on, best suited for his equipment and should make definite specifications accordingly, rather than specify by trade name.

Friendly cooperation between the purchasing and engineering departments can usually be maintained if each department will endeavor to supply only that part of the specification for which their experience and positions qualify them.

C. W. Schwabe
Superintendent Mechanical Department
Mallinckrodt Chemical Works
St. Louis, Mo.

What Maintenance Policy During Depression?

(Question presented in the September issue)

IN most plants it is largely a matter of individual choice. There are cases where a definite policy exists, but no two slack periods would be of the same duration or intensity, so that unless the policy was general, it would not apply in all cases.

There are two sides to every question and this one is no exception. In this case it is management versus maintenance. The head of the maintenance department sees in a slack period an opportunity to get ready for rush seasons, whereas the management, in the face of curtailed business, does not see its way clear to go ahead with projects involving any great expenditure of money.

Equipment should be kept in shape at all times so that there should not be the necessity for a general

(Please turn to page 628)

LUBRICATION SYSTEMS

Pressure Types

By FRED H. LOW
Mechanical Engineer

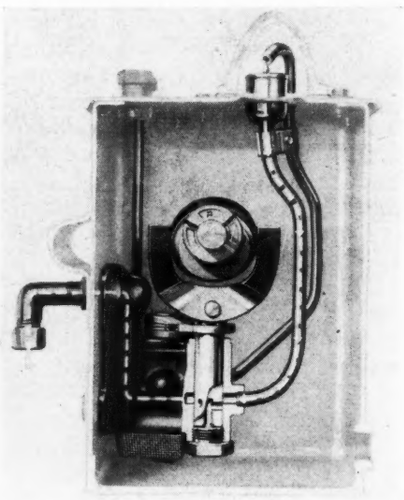
DISCUSSION in this article is confined to pressure lubricators. The type shown in Fig. 8, is designated as a valveless pumping system, wherein the opening and closing of both inlet and delivery ports are controlled by the oscillation of the pump plunger. Fig. 9 shows the cam which raises, lowers, and oscillates the plunger or piston, the dotted lines indicating the position of the cam when the shaft has been rotated through 180 deg. Oscillation through 54 deg. is sufficient to turn the plunger so that one of its ports will register with the inlet on the up or suction stroke and the other with the delivery on the downward stroke. This cam is direct connected to the plunger of the force pump which, in turn, is geared to the metering pump plunger is such a way as to impart both motions to it.

The metering pump plunger operates in a sleeve which may be raised or lowered. In the lowest position of the sleeve all of the oil which has been drawn into the cavity is forced into the delivery line on the downward stroke of the plunger. As the sleeve is raised a waste port in the cylinder registers with a similar port in the plunger, permitting part of the oil to return to the reservoir. The sizes and locations of all ports and working parts are made with such close precision as to allow an adjustment that will split a drop into 48 parts. Adjustment is made by turning the slotted head of the spindle, which is located in the cover.

A sight feed of the gravity-drip type is installed between the metering and force pumps. Check cocks are furnished to prevent the oil from running out of the distributing lines.

This equipment is available in a single pumping unit for handling one bearing or in multiple units for handling several bearings, and although the pumps are designed to operate against back pressures of 300 lb. per sq. in., each unit is tested to operate constantly against a pressure of 2,500 pounds.

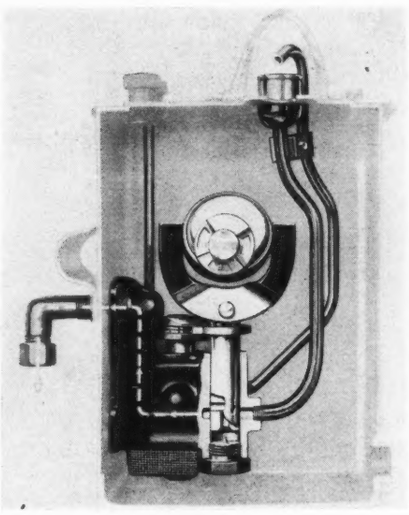
When preferred, a distributor, as shown in Fig. 10, may be incorporated in a single pumping unit. Its function is to meter and force the oil into the lines with the aid of a device for directing the flow of oil alternately to the several leads.

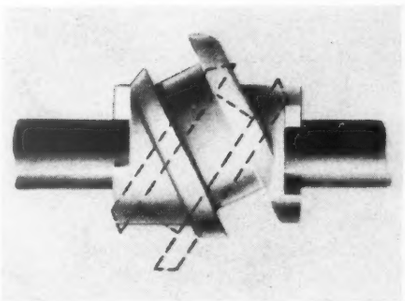


Courtesy Madison-Kipp Corporation

Fig. 8—In the valveless system inlet and delivery ports are opened and closed by the oscillating piston to which motion is imparted by a cam. (Above) With the piston on its upward stroke the suction ports have begun to register. (Right) The cam has rotated 180 deg., causing the piston to oscillate until the suction ports are out of register and the delivery ports in register.

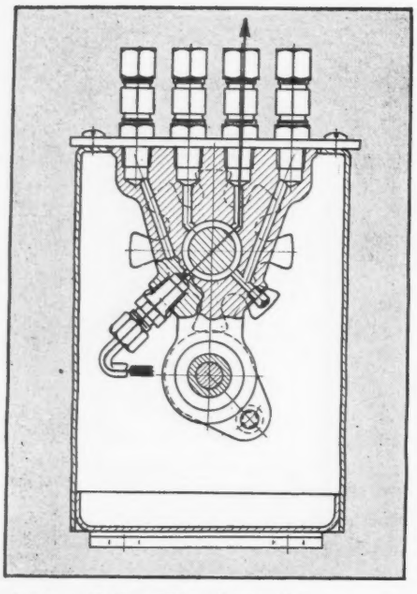
Second article of a series. The next will appear in an early issue.





Courtesy Madison-Kipp Corporation

Fig. 9—The cam which imparts combined reciprocating and oscillation motion to the piston. It causes the plunger to make a total swing of 54 deg., and a reciprocating or lift movement of 0.212 inch.



Courtesy Madison-Kipp Corporation

Fig. 10—Sectional view of lubricator using a single pumping unit and distributor to service several bearings.

An indexing arm on the pump drive shaft engages a star wheel at each turn of the shaft. The star wheel causes a distributing cylinder to which it is attached to index a port with a port in the casing each time the arm moves it through the arc of one point of the star. Thus, as shown in the illustration, eight separate lines may be taken from this distributor.

Although the quantity of oil supplied per stroke of the piston may be regulated, each line obviously will receive the same quantity of oil. However, a variation in the amount delivered to any one bearing may be obtained by connecting two or more outlets to the same lead. Observation of the flow of oil may be made by means of a bleeder, or one of the outlets may be connected to a sight feed.

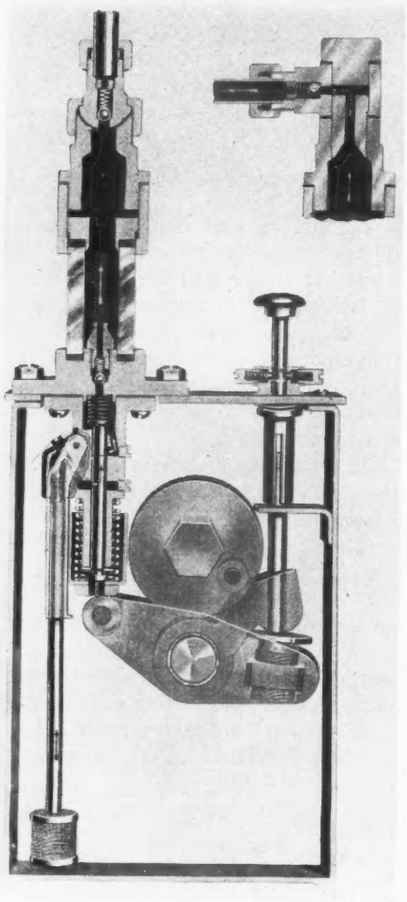
Some manufacturers, believing that twists and turns in the pumping and metering system are the chief cause of air-binding, design their apparatus to operate in a straight vertical line.

Cross-sectional details of a system of this kind are shown in Fig. 11. Each unit consists of a single plunger pump which draws the oil from a reservoir and discharges it under pressure through a fluid-filled sight glass.

The single plunger is operated by a cam through a cam lever and an adjustable regulating rocker lever, this cam shaft being driven by a ratchet, rotary, or direct-lever movement from the equipment lubricated.

No intake valve is used, the plunger itself opening and closing the intake port and measuring the amount of oil pumped at each stroke. A piston valve above the plunger opens and closes the outlet port.

During the forcing stroke the plunger moves forward, closing the intake port. The oil entrapped between the end of the plunger and the piston valve is forced along the bore, while the spring on top of the piston valve is compressed. When the piston valve reaches the point where it uncovers the discharge port, it stops, while the plunger continues on until the stroke is completed, forcing the oil through the discharge port into the glycerine-filled sight glass. The plunger is then returned to its starting position by the spring which forces it back against a stop attached to the cylinder.



Courtesy Manzel Brothers Company

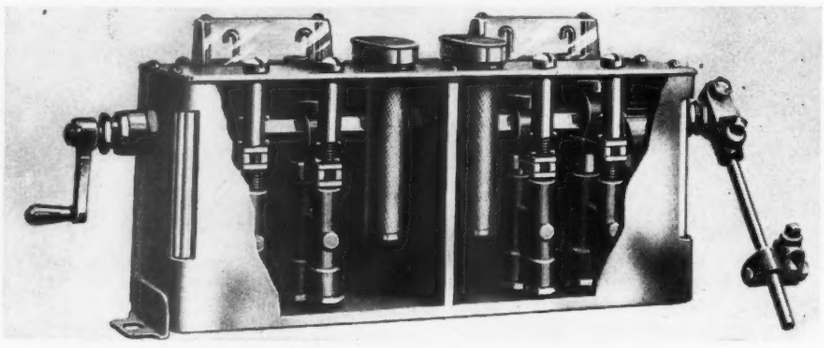
Fig. 11—Pressure sight feed is obtained by forcing the oil from a drip nozzle through glycerine.

During the return stroke the piston valve follows the plunger until it is halted by the collar of the valve coming in contact with the cylinder casting. The plunger and valve then separate and a vacuum is created in the space between the two. The vacuum increases until the suction port is uncovered, when it is broken by the inrush of oil from the pocket on the side of the cylinder. Instantly more oil is drawn up through the tube, replacing that drawn from the pocket.

A deep spring cup, screwed to the end of the forcing plunger, acts not only as a guide for the spring, but also as a container for the oil that forms a fluid seal for the lower end of the cylinder, which is the only point where air could get into the system.

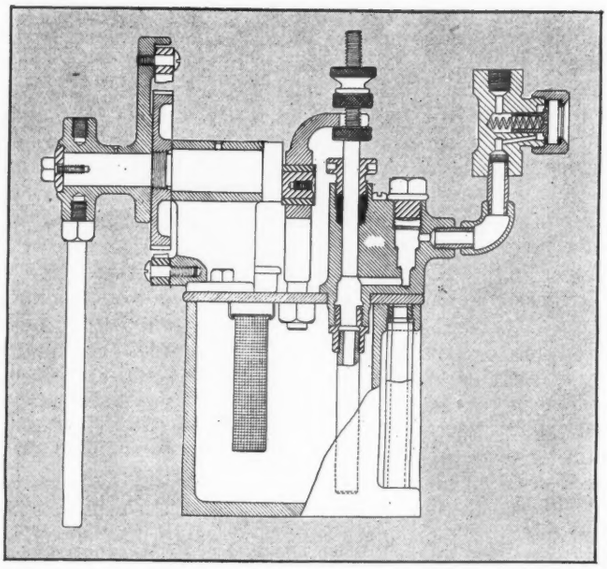
The amount of oil supplied is dependent upon the distance the plunger, on its forward stroke, passes the intake port. This movement is regulated by means of the feed-adjusting screw, or regulator, located on the reservoir cover directly in front of the sight glass. The longer the stroke the greater will be the distance that the plunger passes the port and, consequently, the larger the amount of oil that is metered and forced into the glass.

Adjustment of the feed may be made at any time. A fractional part of a drop may be fed with each stroke, or the supply may be increased to a



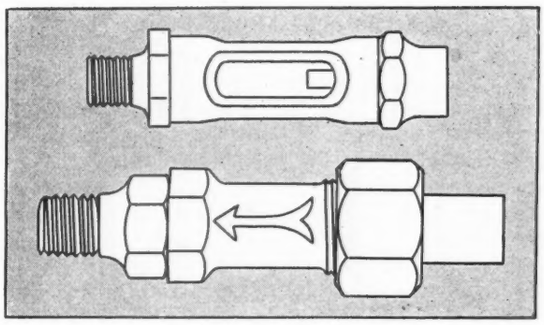
Courtesy Manzel Brothers Company

Fig. 12—A two-pump unit for supplying two kinds of oil. There are two feeds in each compartment. It is recommended for use on steam-driven air and gas compressors.



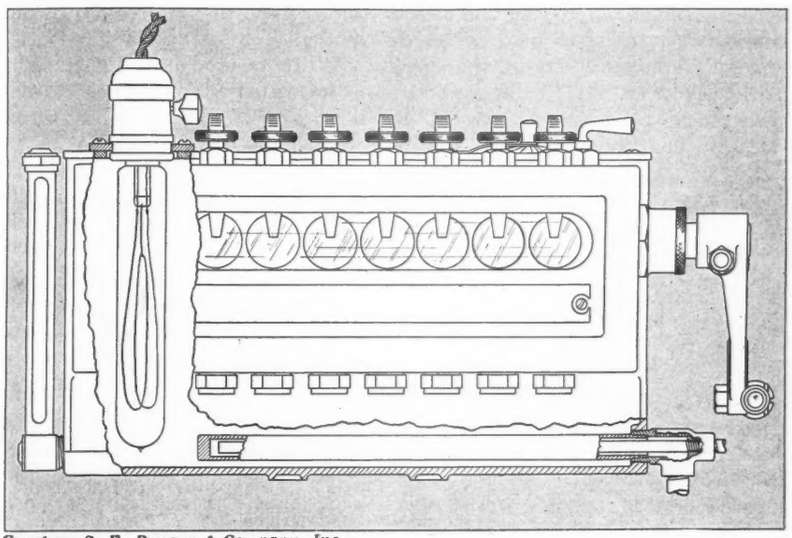
Courtesy S. F. Bowser & Company, Inc.

Fig. 13—A feature of this unit is the location of the pumping mechanism. All working parts are outside the oil container.



Courtesy Hills-McCanna Company

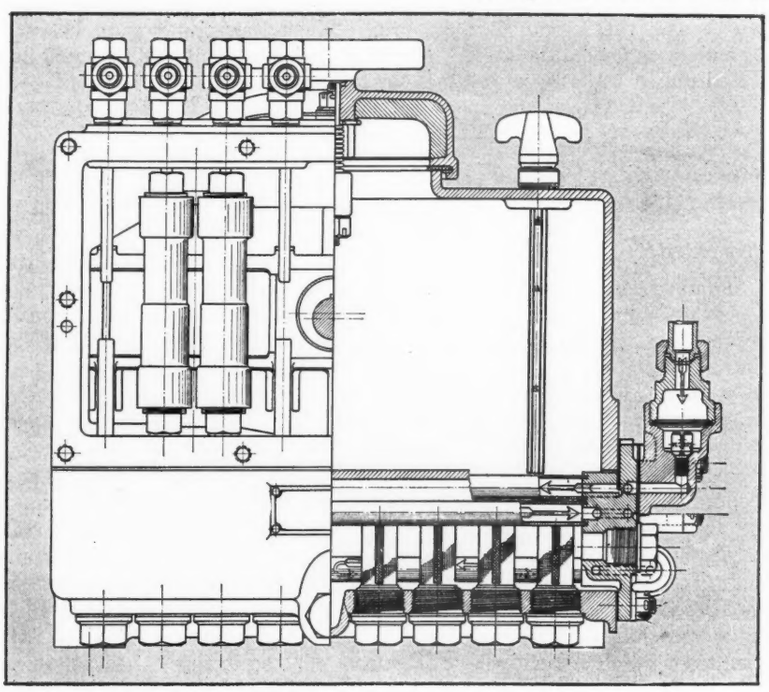
Fig. 14—A drip sight-feed device (*Above*) designed to be used on short lines such as crossheads. The vacuum check valve (*Below*) maintains a constant supply of oil in the line.



Courtesy S. F. Bowser & Company, Inc.

Fig. 15 — Electric-heater units may be used where it is necessary to preheat the oil.

Fig. 16—Where steam is available it may be used to advantage. In this unit the oil in the main reservoir is kept warm, while the oil in the compartment surrounding the suction screws is maintained at a relatively high temperature.



Courtesy Detroit Lubricator Company

maximum of five drops, according to the requirements of the bearing. Two friction springs hold the regulating screw in place and prevent it from turning after the correct adjustment has been made.

Each unit is independently regulated and is capable of very fine adjustment. Neither temperature nor viscosity of the oil has any perceptible effect on the regulator, inasmuch as the plunger always measures out the exact amount for which the unit is adjusted.

The driving cam consists of two steel disks with a steel roller revolving on a pin between them. The roller engages a thumb-like cam lever which makes contact with the top face of the regulating screw attached to the end of the oscillating regulating lever and forces it downward. The opposite end of the regulating lever is fitted with a roller which forces the pump plunger upward. Owing to the

quick action of the plunger this equipment also lends itself to applications where timed lubrication is essential.

A double pump unit, made by the same manufacturer, is shown in Fig. 12. The action of the pump is practically the same as the pump described, the difference in the systems being that the cam gives a continuous action to the plunger. No glycerine is required as the pressure which forces the oil to the bearing is furnished by a second pump. Accessory equipment includes hand crank, two-compartment tanks, and fittings.

Accessibility is featured by the manufacturer of the equipment shown in Fig. 13, in that the pumping mechanism is placed outside of the supply tank. Located at the end of the drive shaft is an eccentric which imparts a vertical reciprocating motion to a shaft that terminates in a series of yokes. These yokes engage the stems of the pump pistons, raising and lowering them by pressure exerted on the adjustable nuts.

Regulation of the amount of oil delivery is made by opening or closing the space between these nuts, reducing or increasing the piston travel accordingly. A pair of nuts at the top permits locking them in place when the proper adjustment has been obtained.

Oil is taken into the pump through a ball-type suction valve in the lower part of the pump chamber and is discharged through a ball check into the lead to the bearing.

Shown to the right in Fig. 13 is the sight feed, which may be installed in any position at any point in the delivery line. It consists of a hollow plunger held by means of a helical spring against a glass disk in an oil-tight fitting. The oil delivered to the inside of the hollow plunger forces its way between the plunger and the glass, giving the impression of an eye blinking.

When desired, this sight feed also is furnished with a ball check, and in a drip-cock type. Drip-nozzle, sight-feed fittings are available but their use is recommended on short lines only as there is no provision for retaining the oil in the line. A vacuum check valve is obtainable for use where there is a possibility of the oil flowing from the line, or steam or water backing up in the line. It consists of a ball check held against the oil pressure by means of a spring. The illustration, Fig. 14, shows these two devices.

These centrally controlled oiling systems are made up in single pump units, also in groups of as many pumps as desired; however, in the larger groups the tanks may be divided so that two or more grades of oil may be handled.

Where it is necessary to heat the oil, practically all manufacturers of lubricating devices furnish steam or electrically heated tanks or heater units which may be installed in their standard tanks. Fig. 15 shows an electric heater so used.

A steam heated unit is shown in Fig. 16, the heating element of which is a hairpin coil. The unit shown is provided with thermostatic control.

Reverse-Phase Relays Not Needed for Hoists

SINCE the report to the annual meeting of the electrical committee of the National Fire Protection Association a number of findings have been recorded with respect to the 1930 edition of the National Electrical Code.

Two of these are of particular concern. The first, dealing with section 1003-k, which has to do with protective equipment on elevators and brought about by an inquiry as to whether the provisions of that section, which call for the use of approved automatic brakes or reverse-phase relays operative in the case of any phase reversal that would cause a reverse motor rotation, apply to motors driving conveyors or hoists when such motors are dependent upon phase relation for the direction of rotation. The finding is as follows:

"No. The paragraph is designed to secure a safeguard against injury to operators and passengers in freight and passenger elevators and to operators in the cabs of cranes. Its provisions do not necessarily apply to all other conditions where phase reversal would result in reverse rotation of the motor."

The second finding concerns section 1102-b, which deals with construction and mounting of transformers and is a ruling on the following question:

"Does section 1102-b refer to current transformers used for metering large services, and, if so, can approved grounded metal cabinets be used to house these transformers without a slate or insulating base?"

The find reads: "Paragraph b of section 1102 makes no exception in the case of current transformers. The installation of transformers and capacitors in metal cabinets does not avoid the necessity for heat insulation when the installation is made upon a surface of combustible material. Sheet metal is not to be considered a non-combustible, non-absorptive insulating material."

Standard Insulator Tests and Ratings Approved

APPROVAL of the American Standard "Insulator Tests and Ratings" has just been announced by the American Standards Association.

This standard which covers insulators for power lines for voltages exceeding 750 volts, is not to be interpreted as forming complete insulator specifications, but rather as defining the methods of making the various tests described when they are required. The standard specifies the complete design and routing tests for pin and suspension insulators. These comprise tests for dry flashover voltage, wet flashover voltage, puncture voltage, and combined mechanical and electrical strengths. Pin insulators are rated according to dry flashover and wet flashover voltages expressed in kilovolts. Suspension insulators are rated according to dry flashover and wet flashover voltages expressed in kilovolts, and also according to combined mechanical and electrical strength. The testing equipment and method of measuring voltage are required to be in conformity with the standards of the American Institute of Electrical Engineers. In an appendix a discussion of the variation of wet flashover voltage with water resistance is given.

AROUND *the* WORKS

THIS SECTION is especially devoted to short articles describing ideas and practical methods devised to meet particular operating conditions. The items may refer to mechanical details of installation, inspection, testing, wiring, repair, maintenance, replacement, and emergency or unusual installations of equipment tributary to production. Special attention is given to shop or bench tools and short cuts or improved methods of handling work brought into the repair shop. Contributions from our readers are always welcome.

Improvised Growler Serves a Variety of Purposes

IN testing the stators of induction motors that we rewind, as well as in testing d.c. armatures, we use a home-made growler which is not very large but fully answers the purpose.

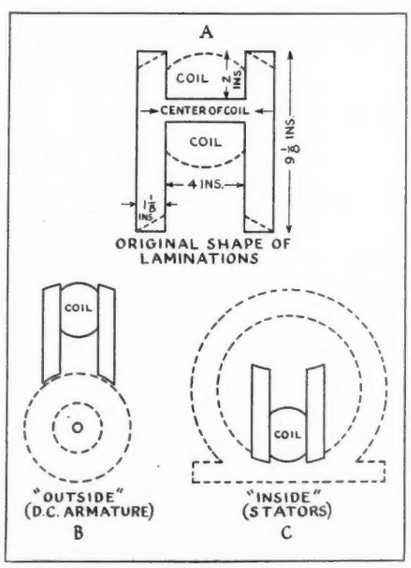
Its core was salvaged from an auto transformer that had burned out while in use on a compensator. The shape of the laminations when removed from the auto transformer were approximately as shown at *A*. Each piece of iron was then trimmed off as shown by the dotted lines in order to use the growler for inside work in induction motors and for outside work on d.c. armatures.

In all, 900 turns of No. 19 s.c.c. enameled wire were placed on the middle of the laminations, which stacked up about 1¼ in. in thickness when firmly compressed. At the center or 450 turns from the start, a piece of No. 18 flexible lamp cord was brought out as a center tap.

This extra tap enables us to use the growler as an auto transformer to secure 110 volts from a 220-volt circuit or vice versa. Sketch *B* shows the use of the growler on a d.c. armature and by reversing the position of the growler as at *C*, it will fit the inside of any of our stators.

When we wish to use a portable, 110-volt single-phase drill in some portion of our plant where 110 volts is not available, we carry the growler along and hook it up to one phase of our 220-volt power circuit and use it as a transformer.

Chief Electrician, CHAS. A. PETERSON.
Cold Spring, Minn.



By reversing the position of the growler as in *B* and *C* inside or outside testing is accomplished. Sketch *A* shows how the laminations were trimmed to provide for the foregoing feature.

Quick Freezing of Pipes for Emergency Repairs

IN many cases new connections and emergency repairs must be made to pipe lines with minimum interruption to service. Owing to the lack of convenient shut-off valves it has often been necessary to freeze a short section of the line before any work could be done on it. When ice and salt are used for this purpose the freezing is slow and not always safe. Recently, a fast and handy method of freezing pipes, in lieu of the shut-off, has been developed through the use of solid carbon dioxide which is also known as "Dry-Ice." The manufacturer of this product gives the following instructions:

With Dry-Ice at 109.6 deg. F. below zero, large water mains under ordinary pressure can be easily and quickly frozen.

Twenty minutes is sufficient time to freeze a 2-in. water line. In the same way lines carrying practically all water solutions, the common acids, and most of the liquids usually handled in industrial plants may be blocked temporarily by freezing. There are, of course, exceptions. Alcohol, ether, acetone, and a few other solvents cannot be frozen in this way.

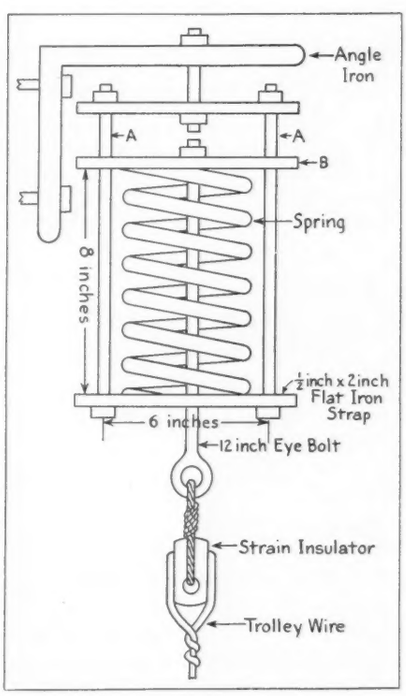
To freeze the line a quantity of Dry-Ice is packed around the pipe on the pressure side of the proposed break. After the repair work has been done, only a short time is required to allow the pipe to thaw. The quantity required for the purpose varies with the pipe size, temperature, time, and other obvious factors.

Spring-Equipped Dead End Prevents Trolley Wire Damage

EXTREME changes of temperature have been responsible for considerable trouble owing to the snapping of taut trolley wires on cranes. This trouble usually happens in extremely cold weather, so to eliminate these disagreeable and costly occurrences an arrangement, as shown, was built. Installation can be made at opposite ends of alternate trolley wires.

It consists of a heavy coil spring which is used to allow contraction and expansion without causing undue sagging or tightening of the trolley wire. The strap *B* is free to slide on the bolts *A*, the spring being compressed when the wire contracts.

The idea was originally noted in an auto tow-rope where it was used to avoid sudden strains when towing in a dead car. On a trolley wire over 300 ft. long, this particular construction functioned perfectly with a wide temperature variation.

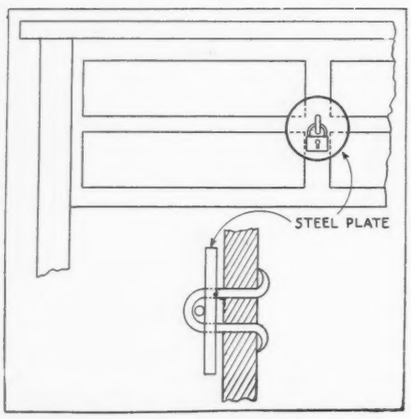


When strain is placed on the trolley wire with this dead-end device in use the snapping of the wire is prevented.

One Lock for Four Bench Drawers

AN ingenious method of making one lock serve for four bench drawers, is shown in the attached sketch. This method is widely used in one shop for securing compartments where tools, gages, and other small parts are kept.

Although the sketch shows circular metal plates, these were used because such plates were available from the surplus material bins. If plates must be made for this use, square plates can be readily cut from stock, by means of shearing.

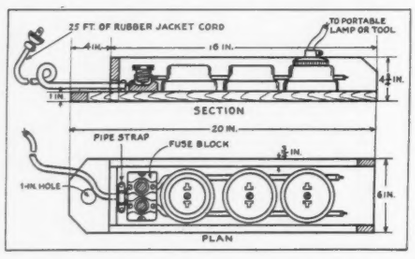


In the upper sketch the lock plate is shown spanning the corners of four drawers. A sectional view is shown below of the heavy wire or steel rod in the form of a staple.

G. A. LUERS.
Washington, D. C.

Portable Connection Box Provides Extra Service Outlets

AN indispensable piece of equipment for construction or repair work is a portable connection box of the type shown in the accompanying illustration. It consists of a box open on one side, made in any kind of wood, having a backboard on which are mounted receptacles wired in multiple. Ample protection is provided by a main line cutout utilizing plug-type fuses.



Details of portable connection box showing principal dimensions and location of fuses and receptacles.

In the assembly sketch cleat-type porcelain receptacles are shown, but sign receptacles or other types including the standard duplex wall receptacle can be used.

For safety the cord should be of the rubber-jacketed or super-service style as used on electric drills in workshop use; the strain being taken by a pipe strap at the outlet end. The hole shown in the end of backboard is intended for hanging up the box when not in use.

A cord-grip type attachment plug should be used, which relieves all strain on the conductors.

Plant Engineer
Factory K
International Silver Company
Meriden, Conn.
JOHN S. ISDALE.

Two-Speed Control for Bandsaw Motors

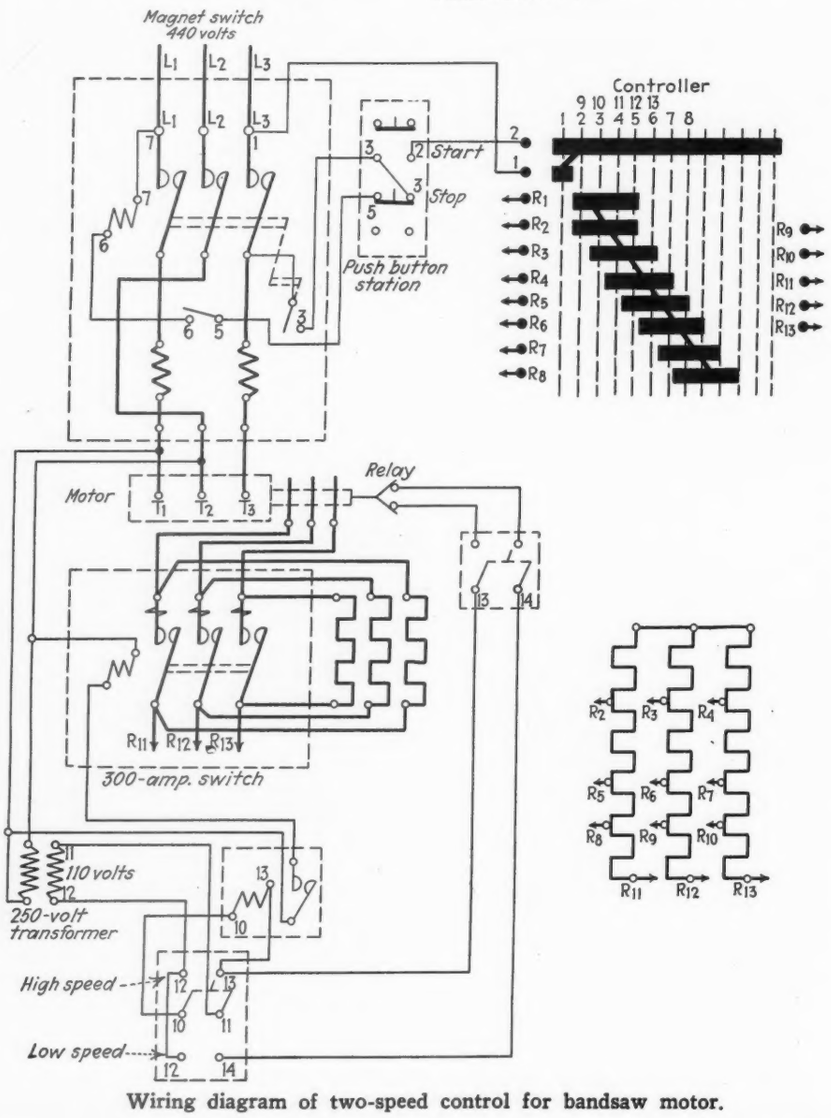
A CONTROL arrangement installed at the mill of the Hutchinson Lumber Company, Oroville. Calif., enables this mill to cut both pine and fir with the same bandsaw. The mill handles practically all pine, but occasionally fir is mixed with the pine and must be cut by the same saw.

The usual tooth speed of a bandsaw for pine sawing is approximately 10,000 ft. per min., whereas fir cut at higher speeds necessitates recutting.

With the assistance of the manufacturers' field representative, the mill installed a method of control which allows the sawyer to drop the saw speed on the smallest of its three bandsaws from 10,000 to 7,500 ft. per min. when changing from pine to fir logs. A small auxiliary section of secondary resistance is used in connection with the standard control governing the slipring motor driving the saw. By means of a centrifugal-type speed relay and magnetic control this resistance is cut in or out of the slipring circuit of the driving motor, thus maintaining close speed regulation of the low speed.

This arrangement has worked out so satisfactorily that similar control is being installed on the remaining saws.

General Electric Company, B. S. HAVENS.
Schenectady, N. Y.



Wiring diagram of two-speed control for bandsaw motor.

Bogies for Belting Buyers

By J. B. TOOMEY
Duff-Norton Manufacturing Company, Pittsburgh, Pa.

IN its fullest sense the belting problem is that of delivering a given amount of power at a given point at the least cost per unit of time.

Mechanical efficiency is by no means the most important factor in obtaining the desired result. It is quite possible, by the utmost engineering refinement, to design and construct a belt drive that will show an extremely low loss of power in transmission. But, with such a drive designed and installed, it may soon be found to be commercially extravagant, involving costs of installation and upkeep that will wipe out all the gain by superior mechanical efficiency.

The belting problem, then, is one of finding that nice balance of relations among transmission efficiency, first costs, maintenance costs, and incidental costs, which will result in *the transmission of power at the lowest cost per horsepower per year over the longest period of useful service.*

Analysis of transmission costs reveals the following factors: cost of belting; cost of repairs and replacements and readjustments; value of power lost between driving and driven pulleys; value of the idle time of men, necessitated by interruption of belting service; value of output lost by idleness of machines dependent upon belting service; and the salvage value of the belt, i.e., its usefulness for other belting purposes after its original purpose may have been served.

Quality

With belting, as with every other product of responsible manufacturers keeping pace with modern methods of making and marketing, the price asked may be considered a fair index to the quality and value offered. With competitive conditions as they are, no manufacturer can hope to hold a place in any market with a fictitious or inflated price. His goods must be worth what he asks, and he must be able to furnish proof.

No one can question the right of any concern to place on the market a product of lesser quality at a lower price. The wrong develops only when that product is offered as "as good as" the better product.

The Six Items of Belt Transmission Costs

In considering the six items of belt transmission costs, the second, third, fourth, and fifth items are in inverse relation to the first item. In other words the higher the first cost of a belt (honest, not inflated, cost), the lower will be the four after-costs in the total cost of belt transmission in all probability. It is evident, also, that the sixth item—salvage value—is most likely to be in direct ratio to the first cost.

If a belt is to be considered only as so much leather, or rubber, or canvas, any price above the current market price of the material per pound or per yard must be considered an exorbitant price. But if the service-rendering capacity be considered, an entirely new and different aspect is given the price situation. And the question becomes, not one of shrewd buying, but of sound judgment of belting values.

It is self-evident that, the better the material in a belt and the better the skill with which those materials are manipulated into the finished belt, the greater will be the enduring qualities and the lower will be the cost of repairs and replacements and readjustments due to excessive stretch, laps opening up, failure of cement, crooked belts, and other belt troubles.

It should be understood readily that the better the material of which a belt is made and the greater the skill and the experience and care with which those materials are worked with a view to the transmission efficiency of the finished belt, the less will be the waste of power in transmission due to slippage, stretching, belt stiffness, and excessive journal friction.

It needs no argument (for instance) to prove that a belt made up of sections of leather butts just as they came from the tannery would have little value for transmission purposes. And the extent to which this rough leather is converted, by special skill through specialized processes, to high-grade leather belting, determines the value and efficiency of the belt as a power transmitter. The value of a belt as an efficient transmitter of power is as much dependent upon the carrying of the leather and the belt-making skill as upon the original quality of the leather—all of which must be paid for.

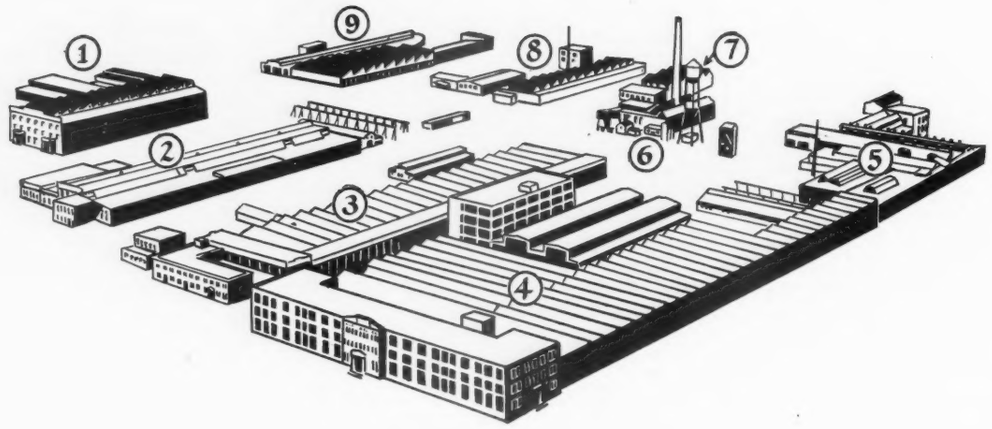
It should be evident without extensive argument that the better a belt is made the less will be the likelihood of breakage and the fewer those necessary repairs and adjustments which put a belt temporarily out of service and shut down all operations dependent upon the service of that belt.

Labor Costs

In most manufacturing operations labor is the chief item of cost, and that labor usually is applied to productive processes through the medium of machines dependent for their power upon some form of transmission. While that power is interrupted by failure of the transmission the costly labor applied through those machines becomes non-productive—a dead expense to be added to legitimate production costs but directly chargeable to the transmission account.

Not alone is labor lost by interruptions of belting service; the normal output of that labor, in finished product, is also lost. And it may well be believed that this loss of output is the largest item chargeable to the belting account. Indeed, an authority states, "In figuring the total expense of belting, and the manufacturing cost chargeable to this account, by far the largest item is the time lost"—which means output lost—"on the machines while the belts are being relaced and repaired."

Story of the Cover



1. **Cincinnati Grinders, Inc.**
2. **The Cincinnati Planer Company**
3. **The Cincinnati-Bickford Tool Company**
4. **The Cincinnati Milling Machine Company**
5. **The Modern Foundry Division**
6. **The Factory Power Company**
7. **The Cincinnati Lathe & Tool Company**
8. **The Alvey-Ferguson Company**
9. **The Cincinnati Ball Crank Company**

THE cover illustration is by courtesy of the Cincinnati Milling Machine Company, of Oakley, Cincinnati, Ohio, whose plant is shown in the foreground. Fortunately, an aerial view of this plant shows, also, most of the other plants of the Oakley Factory colony. The accompanying line drawing and its caption show the locations of the several plants. Cincinnati Grinders Inc., is an associate company of the Cincinnati Milling Machine Company; the Modern Foundry Division makes castings for both plants; and the Factory Power Company supplies electric energy and various utilities services for the colony.

More than a thousand workers are employed in the milling machine plant; the grinders plant has 370; and the foundry has 425. Floor space figures for the three plants are, respectively, 344,000, 148,000 and 155,000 sq. ft. Plant equipment is serviced and kept in repair, and the departments are supplied with materials by a maintenance force of 50 men, which includes engineers and draftsmen. Two men are employed on landscaping.

The main plant is of saw-tooth construction and has a ratio of 35 per cent of glass to floor space, to provide daylight illumination. In the power house are six boilers totaling 2,650 hp., and d.c. generators with a total output of 4,000 kilowatts.

Individual-type suspended cranes with electric hoists are provided over the machine and assembly areas. In the milling machine plant there are approximately 40 chain blocks and 70 electric hoists. Fifteen and 20-ton cranes are used in this plant and the grinders plant.

In the two plants there are electric and gasoline trucks as follows:

Two 6,000-lb., and
Two 10,000-lb., for handling machines;
One 6,000-lb. tiering, for storage use;
Two 6,000-lb. for general traffic;
One 4,000-lb. for high-lift, for storage use;
Two 2,000-lb. for interdepartment traffic.

Tiering cranes are used in handling materials to and from the electric furnaces.

In the foundry electric mules with trailers, and both gasoline and electric trucks are used for movement of the molten iron, for movement of raw materials for furnace charging, and for handling sand cores to and from the ovens. All sand is treated with modern mechanical equipment.

Other equipment with which the plant engineering department is concerned consists of master clock system for time, job, and program control; automatic telephone and personnel call systems; and electric fire alarm and watchman service systems.

Figures giving floor space and numbers of employees in the other plants indicate the size of the colony: The Cincinnati-Bickford Tool Company (drilling machines) 135,800 sq. ft., 400 employees. The Cincinnati Planer Company (metal planers) 110,000 sq. ft., 300 employees. The Cincinnati Ball Crank Company (automotive parts and accessories) 100,000 sq. ft., 275 employees. The Alvey-Ferguson Company (materials handling equipment) 50,000 sq. ft., 250 employees. The Cincinnati Lathe and Tool Company (lathes) 22,000 sq. ft., 110 employees.

Arc-Welding Contest Announced

DESIGNERS and engineers in every industry, where iron and steel forms all or a part of the manufactured product, are again given the opportunity by The Lincoln Electric Company, Cleveland, Ohio, sponsors of the second arc-welding prize competition, to show their skill and ingenuity in utilizing the advantages of arc-welded construction. A total of $17,500 will be awarded for the 41 best papers submitted in the competition.

The competition as announced will be open to any person in the world except the employees of the sponsors. The closing date for the competition will be October 1, 1931.

We Know Our Maintenance Costs . . . *and Here's Why*

By A. G. WYNKOOP
Director of Efficiency
Truscon Steel Company
Youngstown, Ohio

For the sake of simplicity and brevity only mechanical maintenance is considered

BEFORE starting any major task we must analyze the job ahead of us. Mechanical maintenance is a major task, of extreme importance to every plant; so it should receive careful analysis before a definite plan of procedure is adopted. To establish a practical working plan a system should be created that will operate smoothly and economically.

Economical results are sought by all industrial organizations; they should not be governed entirely by expenditure of money. The buying power of the dollar is the true barometer of economy.

The desired results of a system on mechanical maintenance are: (*a*) prompt service; (*b*) good workmanship; (*c*) best possible guidance on all major repairs; (*d*) proper methods to designate the individual costs on each product piece of equipment, major repair job.

To obtain the results outlined, the following procedure has been placed in effect at the Youngstown plant:

In distinguishing between forms of labor requisitions, the term "Repair and Maintenance Order" has been established to cover all requests for maintenance labor. To simplify this term the abbreviation R.M.O. is used.

Form 830-30M-6-29-H34

TRUSCON STEEL COMPANY
REPAIR AND MAINTENANCE ORDER

Copy for: Dept. Foreman, Master Mechanic
Department: "B" Product: Diamond Rib Lath
Description in Full: Complete over hauling and Inspection of Diamond Rib Groover, Expander, Feed Rolls and Dies.

Repair Order No. 20175
Date Issued 12/29/29
Date to be Comp. 1/25/30 A.M. P.M.
Date Completed 1/31/30
Mach. or Die No. 484-943
~~Temporary~~—Permanent Work

ESTIMATED COST

Department Doing Work	Labor Hours	Labor Amount	Material	Total
Machine Shop	850	$850 00	$250 00	$ 1100 00
ESTIMATED TOTAL COST				

Remarks: Savings of $95.25 made account of savings in labor and material not needed

Work Authorized By: Chief Mech Engr.
Estimate O. K.'d By: Gen. Supt.

Fig. 1—A Repair and Maintenance Order (R.M.O.) filled out for a major repair job. When approved it carries the authority for the departments to proceed with their portions of the work.

A series of numbers is issued to be used on the R.M.O.'s, and all charges are accumulated under these numbers. Repairs are divided into two classes:

1. Major repairs, which come under the control of the chief mechanical engineer.
2. Minor repairs, requested direct by the individual departmental superintendents.

Major Repairs

Repairs costing over $50, or those requiring outside purchases, are considered major repairs, for which the following procedure is used:

Where revisions of equipment or breakdowns warrant an R.M.O. for major repairs, the departmental foreman requests the mechanical engineering department to investigate the requirements. This department establishes an R.M.O., using the form shown by Fig. 1. It follows this procedure in making out the order:

Repair order number — Place on the order in sequence. (Draw from a series allotted for this purpose.)

Date issued—Note date written.

Date to be completed—Indicate as a guide to the master mechanic to emphasize the importance of the work, also to enable the departmental foreman to arrange his working schedule.

Date completed—Master Mechanic fills in at the completion of the job.

Machine or die number — Specify to indicate the location of the job.

Temporary or permanent work—Specify to instruct the department foreman and the master mechanic as to what class of workmanship is expected.

Copy for—List for mailing purposes. Copies are provided for: (*a*) the master mechanic, as an order for the work; (*b*) the departmental foreman requesting the work, that he may

Form No. 830-1M-3-29-J5

Repair and Maintenance Order Record

Estimated Cost			
Work Done By	Labor	Material	Total
Machine Shop	$850 00	$250 00	$1100 00
TOTAL	$850 00	$250 00	$1100 00

Description Complete Overhauling and inspection of Diamond Rib Groover, Expander, Feed Rolls and Dies

Repair Order No. 20175
Date Issued 12-29-29
Date to be Completed 1-25-30
Date Completed 1-31-30
Charge Dept "B" Dia Rib

Date	Material From	Material Amount	Machine Shop	Electrical Shop	LABOR Carpenter Shop	LABOR Dept.	LABOR Miscellaneous Labor	LABOR Total Labor	Total Material and Labor	Remarks
	General Stores	$12 52								
	Misc1.	3 30								
	Mach.Shop Stores	120 23								
	Gears	71 61								
	Freight	52								
	Hardware Stores	90								
	Structural Steel	4 36								
	Pay Roll		$785 86					$785 86		
	Liability Ins.		5 45					5 45		
		$213 44						$791 31	$1004 75	

Fig. 2—Repair and Maintenance Order Record compiled by the cost department, detailing the charges against an R.M.O. Copies are sent to the chief mechanical engineer and the general superintendent at the completion of a job.

Form 831 Rev.-3M-4-30-G82

REPAIR AND MAINTENANCE ORDER TAG

No to be used for work done on products

All Information Filled in by Department Requesting Work

Repair Order Number 15040
Order To Machine Shop Dept. Date 5/28/30
Work for Dept. E. STD Prod. or Div. D
Description of Work Please repair
4 A Press
Clutch Slips
Work Requested By Dept. Foreman
Date To Be Comp. 5/29 P. M. Date Comp.
Job Inspected By Inspector Machine or Die No. #55

Stub Filled in by Department Requesting Work

REPAIR ORDER
No. 15040
Work for Dept. E STD
Remarks:
Clutch
Slipping
Machine or Die No. #55

Fig. 3—Repair and Maintenance Order Tag used for repairs costing less than $50, and for which no outside purchases are required. Labor time is indicated on the detachable stub by the employee doing the work.

see the approximate cost of the repairs; (*c*) the cost department, to substantiate its cost account listing the job requirements and estimated costs for actual comparisons; (*d*) the mechanical engineering department, wherein complete data on major repairs as authorized are retained.

Description in full—Give complete description so that no mistake can result from the order.

Estimated Cost—If other than mechanical work is required, such as electrical or building maintenance, each division expense thereof is to be itemized separately on the sheet showing the labor hours, labor cost, material, and total.

Estimated total cost—This item is preceded by the names of the individuals who provide the original estimate. The totals are then extended.

Remarks—This space is made available for any additional data that may be advisable.

Work authorized by—to be signed by the chief mechanical engineer.

Estimate OK'd by—To be signed by the general superintendent.

There are two conditions to consider in this plan, (*a*) emergency repair, (*b*) general repair or improvement.

Emergency Repair

At the time of a breakdown requiring emergency repairs the departmental foreman provides the mechanical engineering department with full description of the conditions, offering suggestions that may be of aid in expediting the repairs. The mechanical engineering department supplies an R.M.O. number and asks that work start immediately. The foreman calls the master mechanic and gives him the R.M.O. number and requirements.

Complete data are placed on the R.M.O., including an estimated cost of the labor and materials required. This estimate is forwarded to the chief mechanical engineer for approval, after which the work is definitely authorized by the general superintendent. The order is then sent to the cost department where copies are prepared and forwarded to each interested party as a final authorization for the work.

The mechanical engineering department is responsible for the purchase of any parts that may be needed. This practice has been established with the objective of adhering to standard equipment. Purchasing through this single channel assures simplification and highly specialized talent.

The method enables the general superintendent to keep in close touch with all major improvements, repairs, or delays encountered in the shop. It enables him to obtain a knowledge of the costs involved in repair work.

It is used, also, by the cost department as a guide in opening proper accounts for recording the costs. All materials purchased or drawn from stores, and all labor spent, are charged to this R.M.O. number, thus providing a complete job cost of each major repair.

Upon receipt of the R.M.O. the master mechanic is assured that all outside purchased materials are ordered, and can arrange his work to coincide with their receipt. The estimated time (Labor hours serves as his guide for force requirements, and creates a competitive spirit among the workmen, who endeavor to complete the work in advance of the estimated

time. This practice, as in an incentive system, presents a definite objective and has contributed much in lowering maintenance costs).

Based on previous operations the time as estimated is found to be nearly correct, but when the actual time exceeds the estimated time the maintenance departments are called upon to account for the discrepancy.

Upon the completion of the job the master mechanic requests the cost department to total all costs and make up cost statements for the chief mechanical engineer and the general superintendent.

The form used by the cost department in recapping the charges as listed against the R.M.O. is illustrated in Fig. 2. This form is self-explanatory and shows how readily the estimated costs are compared with the actual costs charged against the job. The column for remarks is used for indicating the over- or under-runs of actual against estimates.

General Repairs or Improvements

Under general repairs are considered conditions where a machine is to be torn down and given a general overhauling. The authorizing procedure is practically the same, except that a time is selected when the machine can be spared from production. There is an additional step that is incorporated into such mechanical changes, known as improvements. Example of improvements are a proposed change of die or equipment, a change of motors, pulleys, feeds or speeds, and the provision of additional mechanical units on machines to expedite production or reduce man power.

For work of this nature the mechanical engineering department submits complete information to the efficiency department, which is equipped to submit estimates of the results such changes will produce. These estimates are based on the amount of savings in labor costs that will result over a business period of one year. The savings thus listed serve as a proper guide as to the practicability of proceeding with the proposed changes.

Many proposed plans for improvements have been subjected to this procedure. Oftentimes certain production equipment may seem to be antiquated or overmanned, but if the analysis proves that the savings resulting from improving the equipment will not return the expenditure required within a proper time, it is considered advisable to retain the equipment as it is until a more practical design or change can be offered.

Minor Repairs

For minor repairs, which are repairs costing less than $50 and requiring no outside purchases, a simpler plan of procedure has been established.

Instead of requiring an R.M.O. number for each job, accounts are set up to cover general divisions such as a series of like machines, or specific production machines. These accounts are identified by charge numbers known as "Standing Orders for Repair and Maintenance Work." The established charge numbers are given to the departmental foremen that they may order their own repairs as required.

For this method of procedure a Repair and Maintenance Order tag, Fig. 3, is used. It is executed as follows:

Repair order number—Place proper charge number on the card. All labor charged against the account is listed and charged out at the close of the month.

Order to—Indicate the department required to do the work, mechanical, electrical, or building maintenance.

Date—Enter date order was written.

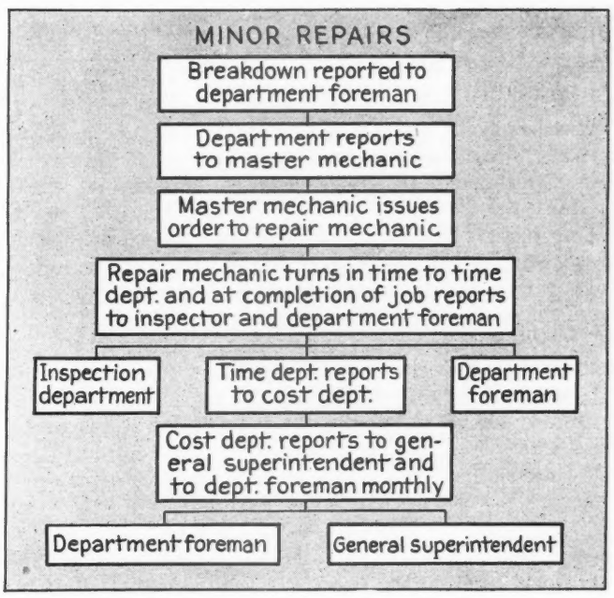
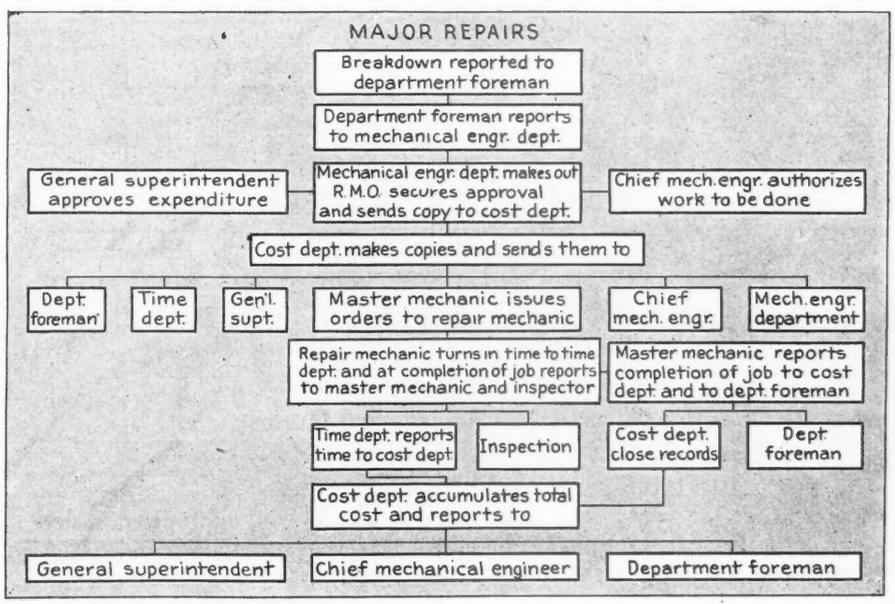

MINOR REPAIRS
Breakdown reported to department foreman
Department reports to master mechanic
Master mechanic issues order to repair mechanic
Repair mechanic turns in time to time dept. and at completion of job reports to inspector and department foreman
Inspection department
Time dept. reports to cost dept.
Department foreman
Cost dept. reports to general superintendent and to dept. foreman monthly
Department foreman
General superintendent

Fig. 5—Schematic layout showing breakdown of the procedure for minor repairs.

Fig. 4—Schematic layout showing breakdown of the procedure for major repairs.


MAJOR REPAIRS
Breakdown reported to department foreman
Department foreman reports to mechanical engr. dept.
General superintendent approves expenditure
Mechanical engr. dept. makes out R.M.O. secures approval and sends copy to cost dept.
Chief mech. engr. authorizes work to be done
Cost dept. makes copies and sends them to
Dept. foreman
Time dept.
Gen'l. supt.
Master mechanic issues orders to repair mechanic
Chief mech. engr.
Mech. engr. department
Repair mechanic turns in time to time dept. and at completion of job reports to master mechanic and inspector
Master mechanic reports completion of job to cost dept. and to dept. foreman
Time dept. reports time to cost dept.
Inspection
Cost dept. close records
Dept. foreman
Cost dept. accumulates total cost and reports to
General superintendent
Chief mechanical engineer
Department foreman

Work for department—State department requesting the work.

Product or division—Name the product or division incorporated under the R. M. O. number.

Description of work—Give a complete description, which will aid the mechanic in obtaining proper tools and replacement parts.

Work requested by—To be signed by the departmental foreman requesting the work.

Date to be completed—Indicates to the workman the urgency of the work.

Date completed—To be noted by the workman who has completed the job.

Job inspected by—To be signed by the mechanical inspector or the foreman requesting the work.

Machine or die number—Specify to indicate the location of the job.

The detachable stub carries in part the same information, and also serves as the workman's means for charging his time.

The R.M.O. tag is made up by the department foreman and is sent to the master mechanic or superintendent of the machine shop. At this point plans are made in accordance with shop conditions and work required.

Equipment parts requiring machine work are delivered to the machine shop with the R.M.O. tag attached. The foreman has the work done. The inspector, if satisfied with the workmanship, signs the tag, and detaches the stub, which he gives to the workman, who presents it to the timekeeper. The stub carries notation of labor time charges. If the department requesting the work has expressed urgent need, it will be notified of completion, so that truckers will immediately call; otherwise the equipment will be moved on regular delivery service.

Repairs requiring millwrights or service men at the point of breakdown are handled in this way:

For general repair, the R.M.O. tag is mailed to the master mechanic who is permitted to schedule his work in accordance with the time specified. Work of this kind is rare; nearly all repairs are needed urgently.

For emergency repair the master mechanic's office is informed by telephone of all information incorporated in the R.M.O. tag which is then attached to the job to identify it, and to outline requirements to the workman designated by the master mechanic. At the completion of the work either the foreman making the request or the departmental inspector approves the job, and detaches the stub so that the workman may indicate on it the labor charge incurred.

In instances where special repairmen are designated to handle certain general repairs the tags go direct from foreman to workman. The sequence of work or preference of jobs is usually decided by the foreman.

All die repairmen, millwrights, and fitters work in squads with certain divisions of the plant to cover, and they are held responsible for giving satisfactory service on direct call. General supervision provides sufficient work at all times so that no idle time is experienced by the group. In former years when everything was working satisfactorily and the maintenance men were idle, the plant was considered to be in first-class condition; however, at present the ideal condition is to retain back-log service work for these groups. Standardized inspection of equipment, dies, and tools, with proper replacement and preventive repairs, have done much in the elimination of breakdowns.

The plan as outlined has placed all the repair and maintenance costs of a division or a specific product machine under one account. The items are totalled at the end of each month and charged as maintenance against the product listed. If any question of excessive charges arises the stubs are referred to and the entries are analyzed.

The adoption of this plan has produced gratifying results, among them: (*a*) maintenance costs are compiled accurately; (*b*) causes of exorbitant costs are located and corrected; (*c*) each foreman is kept informed about costs; (*d*) each maintenance man prides himself on giving prompt and economic service; (*e*) guesswork is taken out of charging time.

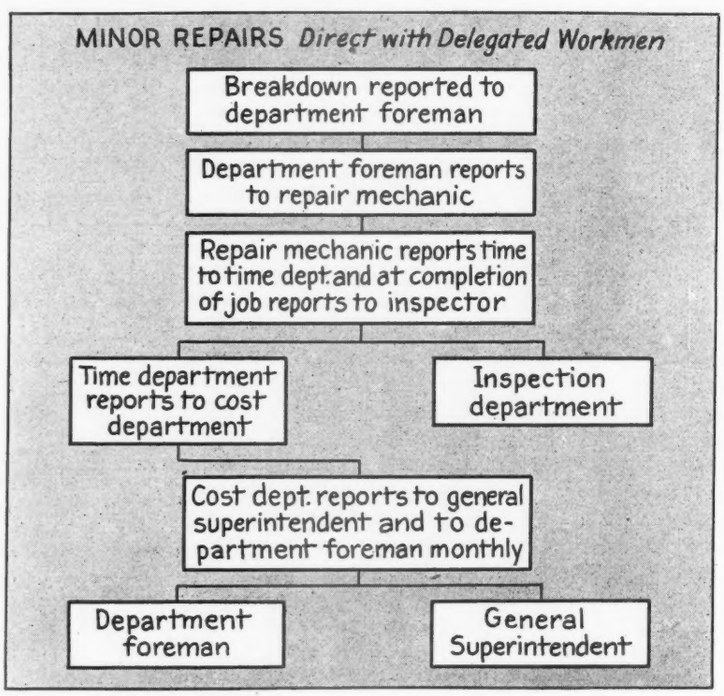

MINOR REPAIRS Direct with Delegated Workmen
Breakdown reported to department foreman
Department foreman reports to repair mechanic
Repair mechanic reports time to time dept. and at completion of job reports to inspector
Time department reports to cost department
Inspection department
Cost dept. reports to general superintendent and to department foreman monthly
Department foreman
General Superintendent

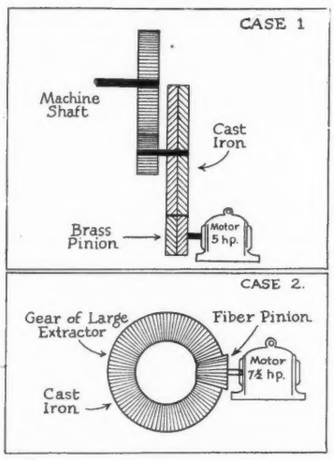
Fig. 6—Schematic layout showing breakdown of the procedure for minor repairs in which designated workmen are utilized.

QUESTIONS *and* ANSWERS

Please submit answers promptly. We expect to publish no answers later than the second issue following the appearance of the question. Selection will be made on the basis of quality, but answers first received have the best chance of being used.

How to Increase the Life of These Pinions?

Case 1: The brass pinion does not hold up at all, and makes a lot of noise. Apparently motor does not have end play.



Case 2: The fiber pinion wears out quickly. Alignment checks up O.K. Motor has ⅛ in. end play.

Can I get longer life from pinions made of other materials? If materials are not at fault what does cause these pinions to wear? S.P.W.

Woolrich, Pa.

Eliminating Explosion Hazard in Cleaning Motors

We clean our motors by placing them under a galvanized-iron hood connected to an exhaust fan and blowing gasoline into every nook by compressed air. The spray hood is large enough to take a 150-hp. motor. The gasoline is not very finely atomized, as the purpose is to flush out the dirt, and we use about 3 gal. in five minutes. There have been no accidents, but are always afraid that a spark may ignite the gasoline vapor. We have considered the use of a nonflammable liquid such as carbon tetrachloride, but it is too expensive. A mixture of carbon tetrachloride and gasoline has been tried, but they are not permanently miscible. Have any readers met a similar problem and found a satisfactory way to eliminate the explosion hazard?

Massena, N. Y. **R. O. K.**

Why Do These Belts Slip?

Considerable trouble is being experienced with the belts used on some across-the-line motors of 1- to 5-hp. rating. Heretofore we have had little real trouble with our belts. No change in quality has been made, so far as we know, but they do not seem to start the load so well with the new motors; after the motor is up to speed the belts apparently carry the load satisfactorily. Frequently a belt slips off when the motor is started. In practically all cases there is excessive slipping and squealing at the start. Two or three times the motor pulley has simply spun around and burnt the belt seriously. Belt dressing does not seem to help much. I shall appreciate it if readers will give me some suggestions on the cause of this trouble, and how to cure it. Is it likely to be due to a poor grade of belt?

Minneapolis, Minn. **G. McC.**

IT is evident that the cause of the belt trouble is not due to the belts themselves, but rather to the type of motor used, to the belt arrangement, or to a combination of both.

Standard squirrel-cage motors when started on full voltage will develop a starting torque of approximately 125 per cent of full-load torque. Motors for across-the-line starting are divided into two classes: standard torque and high torque. The standard-torque motors will develop a starting torque of about 125 per cent of full-load torque, the same as standard motors, whereas the high-torque type will develop about 200 per cent of full-load torque. The starting torque of any squirrel-cage induction motor is reduced as the square of the voltage, when using reduced-voltage starting. The usual reduced starting voltage is 80 per cent, at which the starting torques given above will be reduced to 64 per cent of these values.

Apparently G.McC. had been using standard types of motors with reduced-voltage starting, thus obtaining 64 per cent of 125 per cent, or 80 per cent of full-load torque during starting—a value that did not give belt trouble. In changing over to across-the-line motors belt trouble has developed, as the starting torque is now 125 per cent, if the new motors are of the standard-torque class, or 200 per cent if they are of the high-torque class. Motors of the latter class are usually needed only in cases where a load of considerable inertia or friction is to be started.

Across-the-line types of the standard-torque class of motors can be used successfully if a reasonably good belt arrangement is employed. However, with those of the high-torque class the belts should have a width of 125 to 150 per cent of the usual width. Paper or wooden pulleys should be used to give the maximum belt grip, and idler pulleys should be used if the centers are at all close.

The pulley ratio was not given in the question. For across-the-line motors the maximum ratio used should be 5 to 1 with motors of the standard-torque class, and around 4 to 1 with motors of the high-torque class.

General Engineer, R. P. GUILDFORD.
Westinghouse Electric & Manufacturing Company,
Philadelphia, Pa.

THE trouble with belts not staying on the pulley when starting is due to the high torque and rapid acceleration of these motors. The easiest way to remedy this condition is to put on wider belts, even when wider pulleys must replace the present ones to accommodate a wider belt than would normally be necessary, the purpose being to provide more belt contact surface. With wider belts slipping will be reduced when starting and the motor can accelerate the load, without slipping the belt.

Another expedient can be resorted to with good success. Increase the diameter of both the motor pulley and the driven pulley in the same ratio, so as

to maintain the same speed. Increasing the diameter of the pulleys has the same effect as increasing the width of the belt.

If it is not practicable to resort to either one of these methods, there is nothing left to do but replace these motors with others that have torque characteristics particularly suited to the operation to be performed, which is the proper thing to do when selecting and applying motors.

Milwaukee, Wis. J. F. WISINSKI.

Inspection Schedule for Electric Elevators

Four electric elevators, two for freight and two for passenger service, are to be installed in our plant, and will be under my care —which is a new experience. I assume that some parts require inspection more frequently than others, but do not know enough about it to work out a trustworthy schedule. I shall appreciate it if readers will suggest an inspection routine for the various parts of these elevators that will enable me to keep them in the proper condition.

Chicago, Ill. **W. A. H.**

ELEVATOR machinery may be grouped roughly under the following heads: (1) the hoisting machinery; (2) ropes; (3) pit buffers; (4) hoistway construction; (5) the car and counterweights (this includes the safeties, shoes, and car switch) and (6) the signal system.

I assume that in W.A.H.'s case the hoisting machine is overhead and that all cars are roped one-to-one with full-wrap traction sheaves. Traction sheaves are subject to wear and once or twice a year they should be checked for even wear in all the treads. Uneven wear of sheaves is equivalent to having hoisting ropes of various lengths and, consequently, uneven loading.

If the machines are of the worm-gear-reduction type check the worm for excessive backlash and endplay; be sure that the bearings on the worm shaft take up endplay so that it is not transferred to the armature shaft. Keep the bolts on the coupling, if there is one between motor and worm, tight and the two shafts in line.

The brake must be lined with a high-grade asbestos lining, with the copper rivets well countersunk. In a d.c. outfit dynamic braking assists the mechanical brake in decelerating the car, but in an a.c. job the car is stopped by a mechanical brake actuated by springs which are held back by a magnet when the car is in motion. Oil-filled dashpots cushion the application of the brake. The brakes should be adjusted to ride free of the brake wheel when the car is in motion, but maintain a full contact with the wheel when the car is at rest.

On the control panelboard, keep all dashpots full and the face of all contacts in good alignment.

The rope lubricant used must penetrate to the hemp core, which, in addition to cushioning the strands as they pass over the sheaves, acts as a reservoir of the lubricant.

The factor of safety for the cables on a traction-type machine with a car speed of under 200 f.p.m. should be 10. It is advisable to replace wire ropes of the 6 x 19 construction when any six of the nineteen wires in one strand are broken in the length of the rope. Examine ropes and sockets at least once a month for signs of parting. Resocket and shorten the ropes at least 6 in. on both car hitch and counterweight ends at least once a year. Filler ropes and compensating ropes deserve the same care as the hoisting ropes.

The pit buffers, if of the spring type, need only to be checked occasionally for loose nuts and bolts. If the buffers are of the oil-filled, cylinder-and-piston type they must be checked for oil height, freedom of working parts, and to see that the oil is free from water. The car cables should be of such length that the car rests on the buffers and has opened all limit switches before the weights are pulled into the overhead work.

Care of the guide rails and hoistway construction is relatively simple. Tighten the fishplate and bracket bolts once every six months. The rails should be lubricated automatically. About once in three months the surface of the rail should be cleaned off. In case the rail is scarred from the application of the safety it should be dressed down with a good file. If a car overspeeds and is caught by the safeties the guide rails and brackets must be gone over carefully. A target wire should be strung from top to bottom of each guide rail to check it for perfect alignment, because application of the safety tends to distort the guide rails.

About once in three months clean the contacts on the car switch. Set the safeties, from the car, at least once a month and see that they work properly. Oil all working parts and the cable, if the safety is of this type. When releasing the safety be sure that the cable is in perfect condition and is wound back on the drum evenly. Check it at the sockets, especially. The governor cable must also be inspected every 30 days particularly at the sockets.

If roller safeties are used they must be free in their travel. If the guide rails are well lubricated little or no trouble will be had with the guide shoes. Check the clearance between shoe and rail on each side. On an elevator of 200 f.p.m. speed a total clearance of 0.010 in. is not bad.

Once a month check the travelling control cables from junction box to car for frayed insulation. Keep an extra travelling cable on hand for emergency installation. Make sure, when installing a new travelling cable that the weight of the cable is taken by strain insulators and that none of it hangs on the connections in the junction box or car. If the car has pneumatic door closers check the air hose for leaks every month.

Tighten up all nuts and screws on the car once every six months.

Check the gate interlock to be sure that when the gate is open this switch absolutely prevents movement of the car except when the emergency "by-pass" switch in the car is closed. Test the interlocks at each hatchway door in the same way. This should be done every 30 days in average service. At the same time check the limit switches. See that all door closers, striker plates and toe-guards are secure, clean, and that all working parts are thoroughly lubricated.

Denver, Colo. CARL A. WAGNER.

Is the Distance Between Centers Suitable for This Drive?

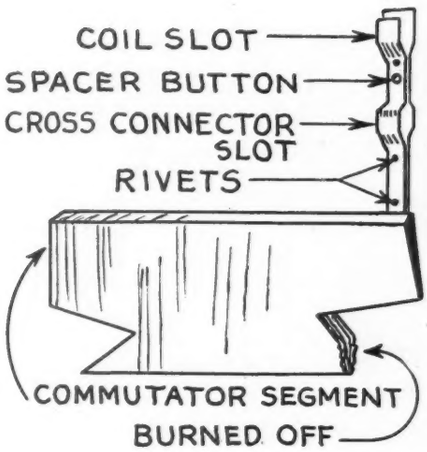
Plans have been made to install a 150 hp., 580-r.p.m. motor carrying a pulley 24 in. in diameter to drive a lineshaft at 278 r.p.m. A 50-in. pulley will be used on the lineshaft, and we will use a composition belt ⅜ in. thick and 18 in. wide. As now specified, the center distance between the motor shaft and lineshaft is 12 ft. 6 in., which I feel is too short for a drive of this size. If I am correct in this, what is the minimum center distance that would be satisfactory? As our space is limited, it may not be possible to use the desirable center distance. In that event, what would readers suggest as the most suitable type of drive?

Newark, N. J. **L. W.**

WITH reference to L. W.'s question, the center distance of the pulleys is three times the diameter of the larger pulley and the pulley ratio is approximately 2:1, so that the belt contact on the smaller pulley will be practically 170 deg. and the drive need not be condemned on this account. If, however, the full 150 hp. is to be transmitted much of the time the net belt tension of 75 lb. per inch of width will require a pretty strong belt, which much be kept very tight if variation in the amount of slip will cause trouble. I believe it would be better to use a combination-tan leather belt, or to widen the pulleys to at least 22 in. and if possible 24 in. and use a rubber belt.

Plant Engineer, H. D. FISHER.
New Haven Pulp & Board Company,
New Haven, Conn.

Fig. 1—Sketch of segment removed from the damaged commutator.



Commutator Assembly

under unfavorable conditions

By E. J. MORRISSEY
Aurora, Ill.

Grounded bars in a 40-in. commutator necessitated immediate replacement. The commutator could not be taken to the repair shop—was rebuilt in place.

AMONG repair men it is a foregone conclusion that field repairs to large commutators should not be attempted if it is possible to take them to better working quarters. However, sometime ago a breakdown job necessitated the rebuilding of a large commutator while in place on the generator.

The generating unit had been installed on the second floor and the building was erected around the unit. Repair shop work on the commutator would have necessitated tearing down the building.

This repair work became necessary owing to a serious ground that had been caused by the breaking down of the insulation in the rear of the bars. The result was that quite a number of bars as well as the retaining ring were seriously damaged. The sketch, Fig. 1, shows the bar assembly.

The commutator was 40 in. in diameter, having 630 bars, each 24 in. long, and a total copper weight of over ½ ton. To support this commutator while tearing it down and rebuilding it naturally required a substantial crib work.

First, the repair work began with the disassembly of brush yoke, pedestals, etc., although in this particular case the pedestals could not be removed owing to the unit being engine driven with the fly wheel on the same shaft as the commutator. To make matters worse lack of room prevented any movement of the pedestal.

Because the building was so poorly constructed it was necessary to build the crib from the ground up to remove the brush rigging and the top half of the generator yoke; the latter being removed more as a convenience than a necessity.

Two cradles were constructed of 2x8-in. timber of sufficient length to

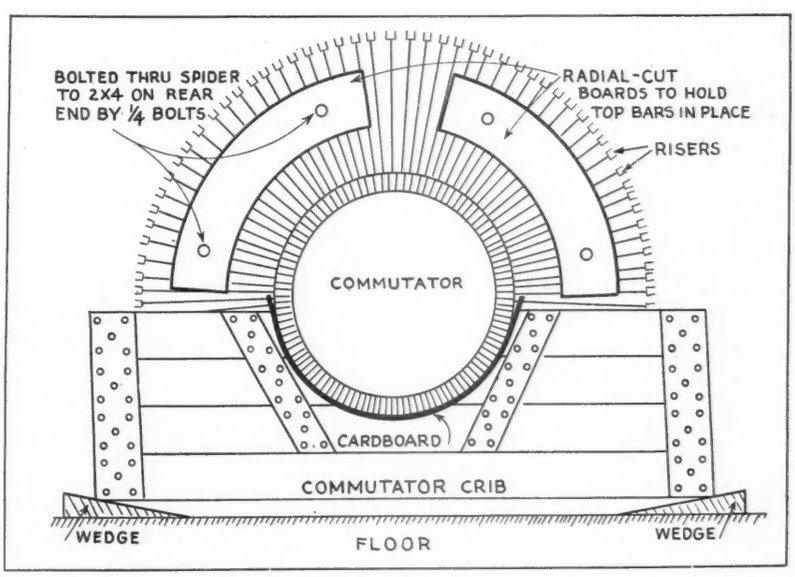


Fig. 2—Wooden cradles were made to support the weight of the commutator. The cradle opening was made slightly larger than that of the commutator to accommodate a cardboard filler.

be supported at both sides of the commutator. These cradles were made with a radius slightly larger than that of the commutator to accommodate a cardboard filler, as shown in Fig. 2. The cribs were then placed under the commutator; one barely clearing the risers on the rear end, the other at the extreme bearing end of the commutator. The cardboard was placed between the crib and risers, and the crib was wedged tightly against the commutator by means of wedges inserted at the base. The crib was then nailed together as a unit and securely braced to prevent side motion.

When support of this kind is used, the end rings can be removed without danger of the commutator collapsing, although another safeguard also be unsoldered. In this case it was found that the best position of these bars for the disassembly operations was the vertical position, that is, for unsoldering, and a little below the horizontal for soldering the new bars.

As the bars were removed, they were examined for defects. As the mica was removed the bars were stacked in order of their condition as found. No attempt was made to save the mica, but all good bars were salvaged.

This procedure was continued while changing the location of the riser supports until the crib support was passed. At this point the crib was removed; the remaining bars were taken out without any fear of the commutator collapsing.

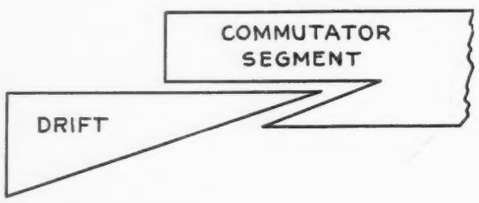


Fig. 3—How a fiber wedge was used in forcing the bars into place.

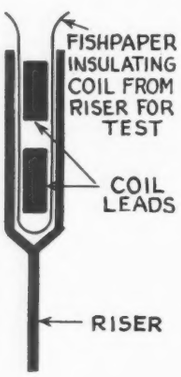


Fig. 4—The method employed in insulating coils from risers prior to testing for grounds and shorts.

can be made at this time for similar protection and which becomes a necessity in the assembly operations. This additional support is made up of two boards with ¼-in. bolts extending through the armature spider and fastened on the rear end of the spider by means of similar boards. These boards, shown in Fig. 2, were arranged so that a space was left between their ends for removing or inserting bars.

With the cradle and other supports in place and the end ring removed, the actual disassembly began by unsoldering the cross connectors. Particular care had to be exercised so that the melted solder did not flow into undesired places.

In unsoldering the cross connectors a small, hot flame was applied and with the use of a sharp screw driver the pockets were pried open. Numerous rags were available to wipe up the surplus solder and flux. Usually when a group of cross connectors is unsoldered in the space allowed by the supporting boards the coils can

When all the bars were removed the two end rings were cleaned of mica, and all other parts were thoroughly cleaned of grease, dirt, solder, etc., resulting from the disassembly operation. Coil and cross-connector ends were heated and wiped; burned spots were cleaned with a chisel and a file. Holes and depressions were smoothed out with iron cement.

As stated before, no attempt was made to save the mica and no time was lost while waiting for the bars and insulation. An intensive cleaning program was instituted for the removal of mica from the good bars. A pot of solder had been provided for cleaning the risers by first dipping them and then wiping off the excess solder. At this time the riveting of the risers to the bar and the spacer buttons was carefully checked; riser necks straightened and opened, so that they would take the main and cross connectors. It was found that the necessary coil and cross connector cleaning or repairs could best be made at this time if the unit was to be in first class condition when the new bars and insulation were received.

Rebuilding began by insulating the rear "V" ring, and stacking at the bottom, alternating insulation and bars. The work progressed at both sides of the center for balance. Care was taken so that the coils and cross connectors went into the proper pockets to avoid the excessive drifting that must be ordinarily used to make the assembly compact, as space is at a premium with the insertion of the final bars.

Up to 60 per cent stacking, the cradle was not used, as the end ring furnished the outer support. No trouble was encountered up to this point but it was felt advisable to put the cradle back in place and to wedge and cross brace it securely. The bars now began to crowd. The end ring had to be removed for convenience and as the bars began to crowd on the cross connector it was necessary to skip those which did not have cross connectors or spacer buttons. Further on, the riser supporting board had to be used to support the bars that were not protected by the cradle so that the remaining bars could be conveniently put in place.

This procedure brought us around the commutator, but we found that we had left out a number of bars which had to be inserted by means of hardwood wedges. This method had its limitations as we found it necessary with the last few bars to heat the bars and mica on a steam table, shellac the mica to both sides of the bar and insert the pieces as a unit. Again we found a limit, for, as we wedged the commutator apart it had a tendency to spread. Two bands had to be constructed to prevent the bars from bulging.

It was during this period that the riser entry was accomplished, using fiber and copper strips. The wedge, shown in Fig. 3, fits into the angle of the bar. In inserting the remaining bars, care had to be exercised, as the commumtator was tight. Forcing in mica insulation against this pressure was difficult. However, the use of a little talcum assisted considerably..

Inasmuch as the skipped bars were distributed over approximately 40 per cent of the commutator, it was necessary to turn the armature to the various positions required.

Insulating the outer ring was done next after the bars had been inserted, as this ring had to be used in its position every time the commutator was turned.

After the end ring was insulated, the risers were also insulated from

their coils and cross connectors with 10-mil fishpaper, after which a test was made for grounds and shorts. This test was also made after the end rings were in position. Full details are shown in Fig. 4.

Insulating the end ring was accomplished in the same manner as the first one; that is, by molding the mica, lapping, splicing, and shellacking it in position on a warm ring which was allowed to cool before putting it in place.

This end ring was then tightened evenly although much care had to be exercised to be sure that the commutator came up equally without bars becoming angularly displaced.

Tightening a cold commutator has its limitations. The final tightening will require a heated commutator. Heat was applied by means of a pipe torch which was constructed of ¾-in. pipe. It was made to encircle the commutator and arranged, as shown in Fig. 5, with a union to allow assembly. Provision was made for ⅛-in. holes for the flames, also, connections for the gas and air required.

As the heat was applied, the bolts were drawn up evenly and as the tightening progressed the machine was run at a low speed.

When we were satisfied that the end rings were sufficiently tight, another test was made for grounds and short circuits, that is, before any connections had been made to the coils or risers. As this test was satisfactory, the coils were soldered, although we found it best to solder the cross connectors first.

Soldering the cross connectors and coil connections was best accomplished by wedging, with the risers inclined slightly below the horizontal. This position permitted the excess solder to run out and away from a troublesome place. For this purpose wire solder was used exclusively. The necessary cleaning was accomplished in the usual manner with hack saw blades, files, sandpaper, etc., ending with a thorough blowing out and a search for minute particles that may have become lodged in dangerous places. When the cleaning was completed the usual tests were then made, and when found satisfactory, a coat of air drying varnish was applied.

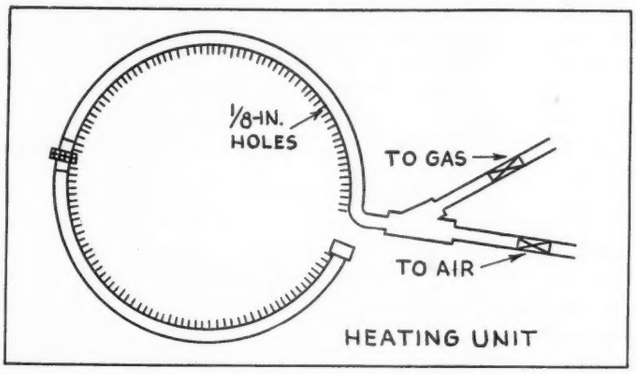


Fig. 5—Details of the gas-pipe torch used in heating the assembled commutator. It was made of ¾-in. pipe bent to encircle the commutator and provided with a union to facilitate assembly.

This work completed the riser and coil portion and the next step was the turning and grinding of the commutator. For turning, a side-cutting tool was used. Grinding was accomplished with the finishing wheel applied against the direction of rotation and at speed between 4,500 and 5,000 f.p.m. All turning, however, was done at about 300 feet per minute.

At best, truing a commutator is a dirty piece of work and the necessary protection should be provided. This feature was obtained by laying a piece of canvas on the commutator and tying it as close as possible to the risers. The canvas was securely tied over the risers, as in Fig. 6.

When the turning and grinding operations were completed, fine sandpaper was used to smooth off the minute marks caused by the tool. Under-cutting was followed by the final polish and cleaning operations, after which the machine was brought up to speed before the brushes were installed, so that centrifugal force could be employed to dislodge any particle that air and other cleaning failed to remove. The generator was then separately excited and its field current brought up slowly to its full value in order to burn out unseen particles.

Although this operation brings us to a completed job (excepting the assembly of the yoke, brush rigging, etc.), the commutator is still green. Commutator building in the factory entails many cycles of assembly, tightening, turning, polishing, and testing; most of which is not generally appreciated by the average operator. Therefore, in shop parlance, our commutator, although assembled, is known as "green." It required further attention such as continued turning and polishing until it became a finished product.

Usually two turnings or preferably grindings will be necessary on a large job to season it, and more if necessary. No reasonable care should be overlooked in properly breaking in a green commutator in order that future troubles may be obviated.

The usual care was exercised in starting up after completing the job, and this concluded one of the most exasperating repair jobs encountered in our electrical repair work, but one that was as interesting as it was painstaking.

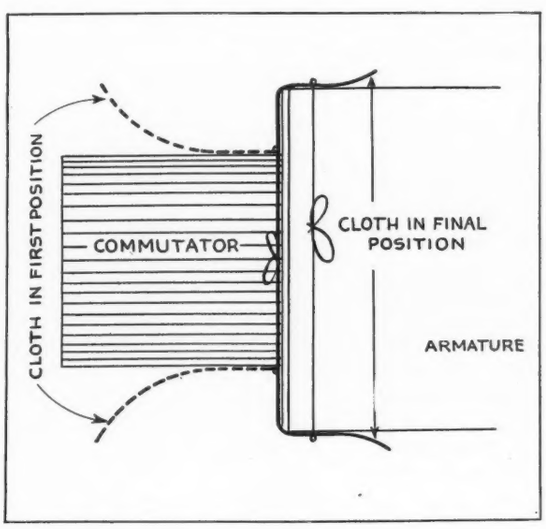


Fig. 6—Canvas cloth was used to protect the risers during the truing operations. The dotted lines show the cloth in the first position. Here, it was secured on the commutator at the base of the risers. It was then drawn up over the risers and tied in the position shown.

(Continued from page 610)

overhauling at any time, thereby obviating the necessity for an extensive maintenance program during slack times.

Slack-time business should effect all departments of a plant alike, as far as policy goes. Our department is running along with the force curtailed to almost the same percentage as the production departments. However, we did not definitely lay off any of our force. The men work two weeks then lay off one week, rather than three days a week because of the nature of our work. They are afforded an opportunity to pick up outside jobs on their off-week which would be more difficult to do for only two and a half days a week.

Equipment such as power transmission and generator units must be cared for regardless of working conditions, but this does not enter into the general maintenance policy that is in any way affected by business depressions.

In summing up the situation I feel that it is far better to have a sufficiently large maintenance force to keep all equipment in good repair at all times and be able to curtail operations along with production, rather than run along on the ragged edge with no factor of safety and have to dig in during slack times.

W. F. Ferguson, *Works Electrical Engineer*
Westinghouse Airbrake Company
Wilmerding, Pa.

WHAT shall be done during a business depression along the line of maintenance, plant changes, and improvements is primarily a question for the management to settle. The policy that is adopted will depend on the financial condition and the standard of maintenance to be desired.

If the financial condition is unsatisfactory I doubt if very much money will be available for the maintenance department, nevertheless the maintenance head should have a program complete with cost estimates and returns to be expected from plant changes and improvements and secure the approval for such work if at all possible.

Assuming that during an extended period of business activity many maintenance and improvement matters have been allowed to stand until a period of business depression opens the way for these matters to be attended to, and for which the maintenance department has been granted a certain amount of money.

A careful department head will spend money only on necessary repairs and on plant changes and improvements that bring tangible returns for the money expended.

Taking the plant from top to bottom, as we might say, a careful program would cover the following: The necessary expenditure should be made to make and keep roofs tight. Leaky roofs mean not only rotting timbers or rusted iron work, but damaged and perhaps, unsalable goods.

Side walls, window sash, and frames should be tight to prevent excessive heat loss during the winter months.

All necessary outside painting should be done to prevent rotting of wood and rusting of metal. All inside painting should be done to insure cleanliness and good light.

Floors should be repaired to prevent accidents to employees and unnecessary breaking of material owing to spilling or jolting of material in transit.

Unless the plant is very old, or if acids and other corrosion-producting materials are used in the process very little will need to be done to the fire-protection system. A careful inspection should be made to determine and complete all necessary repairs.

Heating system, all piping, valves, etc., should be maintained in first class condition. Leaky valves, joints and traps are the cause of considerable waste at the coal pile.

Power plant equipment as a whole will need the most careful inspection, especially if it has been driven hard and given the minimum in the way of repairs. This condition is prevalent if there are no spare boilers.

All electrical equipment should be carefully inspected and thoroughly cleaned, especially switching apparatus of the oil type. If the service has been severe new oil will be required.

Transmission apparatus throughout the entire factory is next in line for general inspection and necessary repairs.

Improper belt maintenance results in greater production loss than is often realized. Shafting alignment should receive careful attention. Where group driving is used or where there is considerable shafting friction plays a heavy role.

Machine repairs must be made on equipment that could not be shut down with the plant operating. Minor repairs on machines that can be done without interfering with production can be allowed to go.

Other improvements, rearranging of machines and machine drives, motor changes, etc., require careful thought and consideration.

Many times I have seen expenditures on plant changes and improvements that were no more than whims without facts or judgment and no benefits accruing to the management for the money expended. The maintenance head had better be called stubborn and behind the times than a party to whimful ideas that are against his better judgment.

For one, I am a firm believer in a continuous maintenance program. The spasmodic program always means hurry! Hurry! HURRY! No time for proper purchase of material; no time to give a foreman to plan or route his materials and men. Good maintenance must have good judgment, good planning, good purchasing, good supervision, and good execution.

F. W. Carter, *In Charge of Power and Maintenance*
Waterbury Clock Company
Waterbury, Conn.

A CONSTANT rush of business very often taxes the maintenance department to its utmost to keep things running and avoid shutdowns, and the consequent interruption of production. At such times improved machinery, tools, appliances, and methods come to our attention, which we acknowledge are better; that they would be good investments, and that we really should have them, but we do nothing about it at the time because we cannot interrupt production. Also, during rush periods we sometimes will not interrupt production long enough to make permanent repairs that are badly needed.

Two cases are used for illustration. In one, as the depression approaches, we start to retrench and curtail expenses. Production is now such that all the necessary time could be taken to do things in a proper and substantial manner and without night or Sunday work.

None of the foregoing is done because there are no orders coming in, and it is felt that such expenditures should not be made while business is poor.

In the other case, repairs, alterations, and improvements are started just as soon as the falling off of production permits. We do not know how long the depression will last, neither do we know just what time will be required to make the desired change. By starting and doing such work at the beginning of a depression, it can be done by the regular maintenance crew in regular working hours. There is time for all necessary experimenting, adjusting, etc. Extra overtime labor costs are saved. Equipment, materials, and labor are usually cheaper during depressions. Better and more satisfactory results can be obtained when such work is not done under the strain of peak production.

Better by far, if there is any time to spare to do the job first and take the spare time later, than to take the spare time first and then find that there is not time enough to do the job as it should be done, with all the consequent ills. We are then ready when business picks up. Not only ready without delay, but in position to make better deliveries and a better product.

Can there be any question as to which is the better policy? It is human nature perhaps, to incline toward curtailment of expenditures as the net income decreases, but, I believe, it is a better policy to prepare for a rush during the depression.

A. W. DURR, *Development Engineer, Akron Plant*
American Hard Rubber Company
Akron, Ohio

Do Centralized or Decentralized Stores Better Serve Maintenance?

(Question Presented in the August Issue)

THIS question undoubtedly has been a matter of controversy in most plants at some time or other. Usually the power plant and other factory departments prefer to keep their own stock and are interested only in having sufficient material available at all times for their own needs. In most cases this means a duplicate stock of many items and a much larger investment than would be necessary under the centralized storeroom plan. It also means that no individual is responsible for the stocks as a whole and the material may therefore be used wastefully due to lack of proper supervision in issuing it.

Having tried both methods I feel that the centralized storeroom is a real economy and that the amount of money invested in stock sometimes can be reduced as much as 40 per cent by the use of this method.

I believe that there are two main reasons why the centralized storeroom appears to be a failure in some plants, namely, lack of co-operation between departments, and lack of proper storeroom supervision.

The power plant and other factory departments must work with the storekeeper and not against him. They should try to anticipate their wants and notify the storekeeper of any unusual requirements as far in advance as possible.

H. E. REINHOLD

Chief Electrician, Dover Plant, American Sheet & Tin Plate Company, New Philadelphia, Ohio, believes in compromising when a maintenance problem is common to several departments.

Most plants, when adopting the centralized storeroom plan, install an elaborate storeroom system, including card records stating minimum amounts of each item to be carried, etc., and then expect the system to function automatically. The stock frequently is put in charge of an old man no longer capable of factory work. This man usually is given several inexperienced boys for assistants and then the storeroom is forgotten until something goes wrong.

Storekeeping should be recognized as a real job and the storeroom should be placed in charge of a man not only familiar with all of the material that he has to handle but who also has a thorough knowledge of the various needs of the plant. Such a man should have no trouble in taking care of all material requirements provided he has the proper co-operation of the purchasing agent and the various department heads. Even though a capable man is employed as storekeeper it will be found necessary to give this department constant supervision because as the needs of most progressive plants are constantly changing and minimums established this month may be worthless as indicators next month.

Decentralized stores may be very popular with factory department heads as a matter of convenience but I believe that an impartial investigation usually will disclose that they are a rather expensive luxury.

C. W. SCHWABE, *In Charge of Mechanical Department*
Mallinckrodt Chemical Works
St. Louis, Mo.

How Big Is Maintenance?

(Question Presented in the May Issue)

CORRECT maintenance inspires invention and improvement of equipment, from the smallest parts of machinery or buildings to the entire plant. The engineering knowledge possessed by the maintenance engineer must be general but thorough.

The maintenance man must unfalteringly face technical and practical problems. He must eliminate the causes of trouble. His methods must be ingenious.

It seems that there can be no definite agreement as to just what maintenance includes, but no matter what the title of the employee engaged in this work his business is to support the very life and existence of all

equipment in either idle or active plant, whether that equipment be machinery, buildings, or other stationary property.

The word "maintenance" has a wider meaning than given by the former literal definition.

It has been said that maintenance is the nurse who fondly cares for the slave equipment preserving its health for the purpose of exacting maximum economical work therefrom.

W. O. HURLBUT
Otis Elevator Company
San Francisco, Calif.

WITHOUT intelligent maintenance our industrial plants would soon be paralyzed. The many steam pipes, water lines, electric wiring, not to mention motors, boilers, engines, gears, belting, and dozens of other items, must function properly in order that production will continue without interruption. The maintenance crew is responsible for this work.

In recent years the medical fraternity has developed a system of preventing diseases rather than waiting until an abnormal condition becomes serious and then treating it. Maintenance crews also have adopted the practice of preventing breakdowns. Thus the Maintenance Department (M.D.) is similar to the regular M.D.

The maintenance department has in its ranks many alert and resourceful men who do not achieve success by being "arm-chair engineers." The more efficiently their work is handled the more smoothly the plant functions.

CHAS. A. PETERSON, *Chief Electrician*
Cold Spring Granite Company
Cold Spring, Minn.

Should Maintenance or Production Department Control Cranes, Elevators, and Trucks?

(Question Presented in the April Issue)

CRANES, elevators, and trucks are in existence primarily to serve productive departments. Then why should they not be operated by the departments which they serve?

The plan which I have found to be entirely satisfactory is one in which the maintenance and repair of all this equipment is the direct responsibility of the plant engineer.

The operators are employees of the plant engineer's department.

The crane operators are classified in the electrical division; elevator operators, electric truck operators, and automobile truck operators are classified in the transportation division. The division leaders in each case are held directly responsible for the cleanliness, the lubrication, the general condition and the operation of the equipment. They are held responsible for the behavior of the men operating the equipment. Yet it is their duty to meet the requirements of the department in which they are working.

Each operator, whether he be for crane, elevator or truck, is expected to properly lubricate and clean whatever he is operating and to report anything which, in his opinion, may not be operating correctly or may seem out of alignment or showing signs of wear.

Hoisting cables and all hoisting equipment are under constant observation and all defective cables or cables which have been knowingly strained to a point where they have been seriously overloaded, are immediately removed and new cables are installed.

It is my opinion that no better plan can be developed for the operation of this type of equipment. I believe there is no one better qualified in any plant to properly maintain this equipment than the plant engineer. He has millwrights, riggers, electricians, and machinists, together with laborers and helpers.

Having the operators of this equipment come directly under his supervision enables the plant engineer to keep himself informed relative to the condition of the equipment so that a minimum amount of money need be spent for repair maintenance and repair.

All that is necessary, so far as the productive departments are concerned, is that the operators be properly instructed that it is their duty to make the particular equipment that they are operating perform its full duty to the department in which it is installed and that this service be rendered in a courteous manner.

HARRY W. BENTON, *Plant Engineer*
Pratt and Whitney Company
Hartford, Conn.

I THINK it is better for the maintenance department to have full control of the operation of all cranes, elevators, and trucks because the maintenance department understands how they should be operated. The best method of operation will be taught and the maintenance will be more efficient.

On the other hand the production department should have control of the operators in regard to giving them orders to haul materials about in their departments.

FRANK OLNEY, *Maintenance Foreman*
Relay Motor Corporation
Lima, Ohio

MATERIALS handling equipment, to keep production up to the planning department's schedule, must have but one responsible head, who in turn must have a crew of mechanics, electricians, and operators especially trained in servicing such equipment.

Timing the production line, scheduling trucks for delivery and return, can be done by planning department in conjunction with the maintenance man's reports of condition of equipment (such as trucks up for repair or conveyors due for overhaul).

My solution is one maintenance head with sub-groups for general shop equipment, mechanical equipment, materials handling, and power equipment. These groups include the electricians, machinists, carpenters, millwrights, lubrication men, and materials handling operators. Their respective duties are outlined and impressed upon them and the importance of co-operation of each group in maintenance work explained and taught so as to avoid the bane of production troubles, namely passing the buck on a breakdown. One executive head cures that.

CHAS. H. WILLEY, *Assistant Plant Superintendent*
Hoyt Electrical Instrument Works
Penacook, N. H.

INDUSTRIAL ENGINEERING'S DATA SHEETS

Motor Wiring Tables

(Continued from the November issue)

2,200-VOLT, TWO-PHASE, SQUIRREL-CAGE INDUCTION MOTORS

Hp.	Full load Amperes	Wire size Gage No. or circular mils		Conduit size for 3-conductor lead-covered cable	Running protection** max. setting time limit protective device Amperes	Branch circuit protection reduced-voltage starting	
		Rubber covered	Varnished cambric			Max. rating fuses*** Amperes	Max. setting time limit protective device*** Amperes
25	6	14*	14*	1¼	7.50	15	12
30	7	14*	14*	1¼	8.75	20	14
40	9	14*	14*	1¼	11.25	25	18
50	11	14*	14*	1¼	13.75	30	22
60	13	12*	14*	1¼	16.25	35	26
75	16	12*	12*	1¼	20.00	40	32
100	22	8	10	1½	27.5	60	44
125	27	8	8	1½	34.0	70	54
150	31	6	8	2	39.0	70	62
200	43	4	6	2	54.0	90	86

2,200-VOLT, THREE-PHASE, SQUIRREL-CAGE INDUCTION MOTORS

25	7	14*	14*	1¼	8.75	20	14
30	8	14*	14*	1¼	10.00	20	16
40	10	14*	14*	1¼	12.50	25	20
50	13	12*	14*	1¼	16.25	35	26
60	15	12*	12*	1¼	18.75	40	30
75	19	10	12*	1¼	23.75	50	38
100	25	8	8	1½	31.50	70	50
125	32	6	8	2	40.00	70	64
150	36	6	6	2	45.00	80	72
200	49	4	6	2	61.50	100	98

*It is generally considered better practice to use no wire smaller than No. 10 at this voltage.

**Circuit-breakers are required for the running protection of motors operating at this voltage. N.E.C. 5006-a.

***It is generally considered better practice to use circuit-breakers for the protection of motor circuits operating at this voltage.

INDUSTRIAL ENGINEERING'S DATA SHEETS

Motor Wiring Tables

(Continued from the preceding page)

2,200-VOLT, TWO-PHASE MOTORS, WOUND-ROTOR INDUCTION AND REACTANCE-TYPE, SQUIRREL-CAGE

Hp.	Full load Amperes	Wire size Gage No. or circular mils		Conduit size for 3-conductor lead-covered cable	Running protection** max.setting time limit protective device Amperes	Branch circuit protection wound rotor		Branch circuit protection high-reactance type	
		Rubber covered	Varnished cambric			Max. fuse*** rating Amperes	Max. setting time limit protective device Amperes	Max. fuse*** rating Amperes	Max. setting time limit protective device Amperes
25	7	14*	14*	1¼	8.75	15	10.5	20	14
30	8	14*	14*	1¼	10.00	15	12.0	20	16
40	10	14*	14*	1¼	12.50	15	15.0	25	20
50	12	14*	14*	1¼	15.00	20	18.0	30	24
60	14	12*	14*	1¼	17.50	25	21.0	35	28
75	17	10	12*	1¼	21.25	30	25.5	45	34
100	22	8	10	1½	27.5	35	33.0	60	44
125	27	8	8	2	34.0	40	40.5	70	54
150	32	6	8	2	40.0	50	48.0	70	64
200	45	4	6	2	56.5	70	67.5	90	90

2,200-VOLT, THREE-PHASE MOTORS, WOUND-ROTOR INDUCTION AND HIGH-REACTANCE TYPE, SQUIRREL-CAGE

25	7.5	14*	14*	1¼	9.50	15	11.25	20	15
30	9	14*	14*	1¼	11.25	15	13.50	25	18
40	11	14*	14*	1¼	13.75	20	16.50	30	22
50	14	12*	14*	1¼	17.50	25	21.0	35	28
60	16	12*	12*	1¼	20.00	25	24.0	40	32
75	19	10	12*	1¼	23.75	30	28.5	50	38
100	25	8	8	1½	31.5	40	37.5	70	50
125	31	6	8	2	39.0	50	46.5	70	62
150	37	6	6	2	46.5	60	55.5	80	74
200	52	4	4	2	65.0	80	78.0	110	104

*It is generally considered better practice to use no wire smaller than No. 10 at this voltage.

**Circuit-breakers are required for the running protection of motors operating at this voltage. N.E.C. 5006-a.

***It is generally considered better practice to use circuit-breakers for the protection of motor circuits operating at this voltage.

BOOKS
for your personal library

Techno-Dictionary German—English—Italian

By Hubert Hermanns, author and publisher, 64 A Dahlemer Strasse, West Lichterfelde, Berlin, Germany. Size 4¼x6 in.; 411 pages. Price, $3.75.

FOR the readers of foreign technical periodicals, the author, in this second edition, offers an enlarged collection of technical terms pertaining to metallurgical, foundry, factory, and workshop practices. All terms are readily available in three languages, English, German, and Italian.

Although the dictionary is divided into three parts, the terms used in each are identical. In the first part the terms appear in German with the English and Italian equivalents following in light type. The second part contains the terms translated from the English into German and Italian, whereas the third part covers the English and German translations of the terms in Italian.

Temperature conversion tables as well as tables of measures and weights also are treated in the same manner to facilitate translation in the three languages.

NELA 1930 Proceedings

Volume 87 Published by the National Electric Light Association, 420 Lexington Ave., New York, N. Y. Cloth, 9 x 12 in., 1,444 pages, illustrated. Prices: Members $10, non-members $15.

VOLUME 87 of the proceedings covers the administrative year ended June 30, 1930, and contains: (a) The official transcript of the 53rd convention held at San Francisco, Calif., June 16 to 20, 1930; (b) Reports of National sections, and special and general National committees issued during the administrative year; (c) Pertinent association information and statistics of the industry.

In the list of NELA publications its reference number is 0100.

Underwriters 1930 Standard Regulations

TWO 1930 editions, "Regulations for the Construction and Operation of Pyroxylin Lacquer Manufacturing Plants," and "Regulations for the Protection of Openings in Walls and Partitions Against Fire," published by the National Board of Fire Underwriters, 85 John St., New York, N. Y., are now ready for distribution.

Dates effective are July 1, and Oct. 15, 1930, respectively. The latter edition supercedes the 1927 pamphlet, whereas the first-named, dealing with pyroxylin lacquer, is a first edition prepared as a guide to good practice in the field.

American Standards Refrigerator Safety Code

Published by the American Standards Association, 29 W. 39th St., New York, N. Y. Price $0.30.

A NATIONAL safety code for mechanical refrigerators of all types, both domestic and commercial, has been approved by the American Standards Association. Refrigerating apparatus used in the manufacture and processing of materials such as in ice-making plants, cold storage warehouses, ice cream and dairy plants, packing houses, and chemical plants, and also cooling systems of theaters and other buildings are covered in the provisions of the code which was prepared by a technical committee of the American Standards Association working under the direction of the American Society of Refrigerating Engineers.

The code applies to both direct methods of refrigeration, in which the refrigerant is circulated through the systems, and to the indirect, in which brine or water cooled by the refrigerant is circulated through the system.

Nema Motor and Generator Standards

Published by National Electrical Manufacturers Association, 420 Lexington Avenue, New York, N. Y. Designated as Publication No. 30-2. Brown linen covers; 132 pages. Price, $1.50.

THIS book contains much valuable reference information on application, selection, ratings, tests, construction, guarantees, and business policies; also, comprehensive lists of definitions and abbreviations of terms pertaining to motors and generators.

The material covers motors, generators, frequency converters, and industrial motors over 60 cycles, large synchronous motor-generators, elevator motors, a.c. crane motors, d.c. motors for machine tool and similar applications, d.c. motors for direct connection to centrifugal fans, farm lighting generators, and so on.

Standard rated voltages, frequencies, speeds, horsepower or kilowatts, and short-time ratings are given for the above equipment.

Performance standards show efficiencies, power factor, temperature rise, and allowable variations from rated voltage and frequency. For motors, standards are given for torque (starting, pull-in, overload, and breakdown), for speed changes due to temperature rise and overheating, and for speed limitations of motors driving through belts and gears.

Much of the material is new, having been developed since the Association published in 1928 standards on motors and generators in its Apparatus Standards. All material previously published has been revised and rearranged. Four new sections have been added on frequency converters for industrial purposes, synchronous motor-generator sets, and large synchronous motors.

Appraisers and Assessors Manual

By W. L. Prouty, Frank H. Prouty, members, Prouty Bros. Engineering Company, and Clem W. Collins, member, Collins, Witting & Company, Denver, Colo. Published by McGraw-Hill Book Company, 370 Seventh Ave., New York, N. Y. Cloth, 6x9 in., 500 pages, illustrated. Price $5.

ALTHOUGH this book was written primarily to meet the needs of the practicing assessor and appraiser, it also may be found useful by the engineer, architect and other executives who are interested in methods by which property (plants, etc.), values can be determined. The information contained is intended to enable readers to develop a system which will meet individual needs rather than lay down a fixed system of definite rules universally applicable to every locality.

On the premise that structures differ in type, use, cost, life, and depreciation, the general principles propounded can be applied to meet every need for correct valuations. Accordingly, the material is arranged in definite sequence for the individual to use intelligently.

As a manual for the engineer and plant executive, it is complete with tables and other data pertaining to building ordinances, building construction, building labor and material costs, material classification, construction methods, age and depreciation of buildings, valuations of buildings, obsolescence of buildings, land valuation, valuation of mechanical and electrical equipment, normal life of industrial equipment and so on.

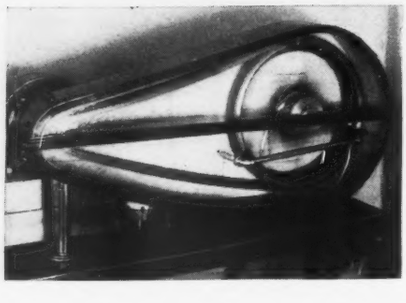
EQUIPMENT NEWS

Industrial plant executives concerned with the selection and operation of mechanical and electrical equipment will be interested in these devices, which are designed to improve plant operation or reduce operating and maintenance costs.

Morse Automatic Ring Oiler for Chain Drives

CHAIN-DRIVE lubrication equipment, consisting of an automatic ring oiler, has been announced by the Morse Chain Company, Ithaca, N. Y. This device is designed so that only clean oil is carried up and onto the chain. The ring is made from rod steel, with the ends sweated together. It travels in a groove turned in the hub of one of the sprockets.

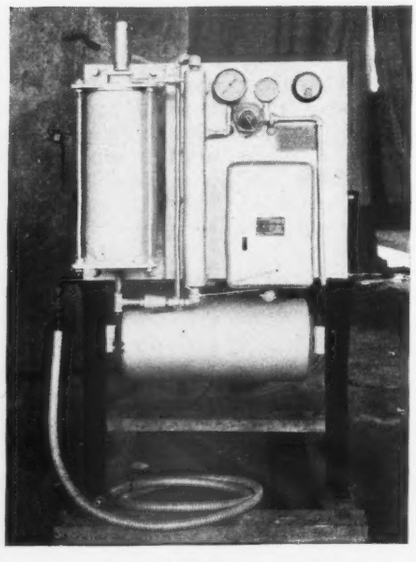
Oil is taken off the ring by means of a wiper, carried in a pipe to near the center of the chain, and then dropped on the inside of the chain. This method of lubrication, it is stated, eliminates the possibility of oil being churned into a mist and seeping out through the case.



It also prevents the heating of the oil to an undesirable temperature, and the carrying of dirt to cause unnecessary abrasion of the chain and sprockets.

General Electric Ammonia Dissociator

EQUIPMENT for the dissociation of anhydrous ammonia to obtain hydrogen, suitable for use in atomic hydrogen welding operations, has been introduced by the General Electric Company, Schenectady, N. Y. Enough dissociated gas is supplied per hour, at atmospheric pressure and temperature, to operate a 1/8-in. electrode holder for current values up to and including 70 amp. The pressure of the gas at delivery does not exceed 10 lb. per sq. in. The equipment is provided with suitable temperature control and indicating devices, regulator, and safety devices. It



has a rating of 3.5 kw. at 220 volts

The dissociator consists of an electrically and thermally insulated alloy tube filled with an ammonia cracking catalyst and connected to a low-voltage, high-current transformer. Suitable inlet and outlet tubes and openings for temperature indicating and controlling devices are provided.

As soon as the arc is struck the gas will flow and when the arc is broken the gas will stop. It is not necessary for the operator to start using gas as soon as the operating temperature is reached in the dissociator.

Inland Steel Roofing

INLAND Steel Company, 38 South Dearborn St., Chicago, Ill., announces the addition of another roofing sheet, Perfect Drain Channel Roofing, to its line of products. This roofing provides a triple barrier against water. It cannot be laid incorrectly, and it may be used in siding as well as roofing factories, storehouses, sheds, and other structures. It is made of galvanized, open-hearth steel.

Clark "Clarktor" Crane

THIS variable-height crane, introduced by the Clark Tructractor Company, Battle Creek, Mich., is capable of lifting 2,000 lb. to a height of 13 ft. When the boom is horizontal, the crane's overall height is 7 ft. 10 in., making it easy to negotiate plant and warehouse doors. Among the uses suggested for it is the handling of heavy castings and forgings.

Crates, boxes, and other loads requiring chains and hooks can easily be tiered, thus enabling the plant to conserve floor space.

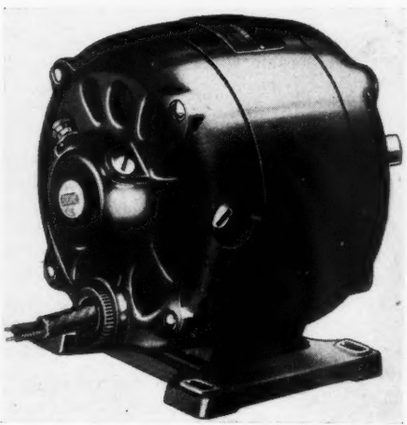
The chassis is the same as that used in the tructractor, and which has a turning radius of 108 in. Accessories include self-starter, generator, battery, head and tail lights. It employs standard truck transmission and disk clutch.

Trumbull Electric Acquires Drendell Electric Manufacturing Company

ACQUISITION of the Drendell Electric Manufacturing Company, San Francisco, Calif., manufacturer of panelboards and switchboards, by The Trumbull Electric Manufacturing Company, Plainville, Conn., has just been announced. Amalgamation of the organization became effective Nov. 1, under the name of "The Drendell-Trumbull Electric Manufacturing Company."

Bodine Motor with Wool-Packed Bearings

A FRACTIONAL-HORSEPOWER motor, designated Type N-5, which will ultimately replace the older SA and SD motors, has been announced by the Bodine Electric Company, 2254 W. Ohio St., Chicago, Ill. Two frame sizes are now available in the following ratings: 1/20 and 1/12 hp. at 1,125 r.p.m.; 1/10 and 1/8 hp. at 1,725 r.p.m. Frames



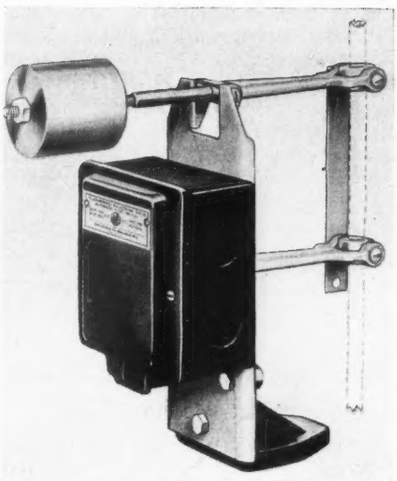
are equipped with wool-packed bearings.

Double oil slots at the sides of the bearing provide double-contact areas for the wool packing on the motor shaft. A dust-tight cap is used to exclude grit and dust.

Allen-Bradley Automatic Float Switch

BULLETIN 840 float switch, which provides automatic motor control for pumps and similar equipment supplied with float control, has been introduced by the Allen-Bradley Company, 1311 South First St., Milwaukee, Wis. This unit is of the contactor type operated by an arm working against a cam leverage which assures a quick make-and-break of the contactor.

Size B is made in four forms and various combinations with or without



overload breakers, disconnect switches, and fuse clips. It provides two-pole switching, and handles a.c. motors up to 1½ hp., 110 volts, and 3 hp., 220, 440, and 550 volts. The d.c. rating is 1 hp., 110 or 220 volts. For larger ratings, the switches can be used as pilot control for magnetic starters.

Size C provides three-pole switching and is rated for single-phase motors up to 1½ hp., 110 volts and 3 hp., 220 volts; for polyphase motors up to 3 hp., 110 volts and 5 hp., 220, 440, and 550 volts; for d.c. service 2 hp., 110 and 220 volts, 1 hp., 550 volts.

Trent Heating Elements

HAROLD E. TRENT COMPANY, 439 North 12th St., Philadelphia, Pa., has added to its line, the Type IR Junior immersion unit illustrated.

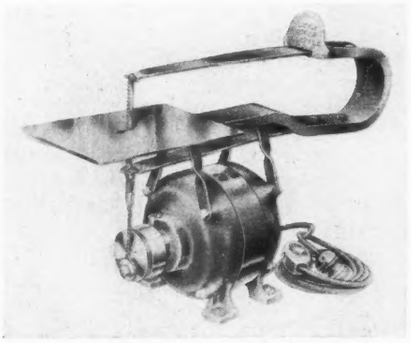
These heating elements have been constructed to be interchangeable with other elements of a similar character. This unit is made for stock purposes with a seamless brass tube, but bodies made of copper, steel, or chrome-steel

alloy tubes are available. In the standard elements, the heat is distributed over the entire length of the unit, but when necessary, heat concentration at different positions along the tube can be provided.

Beebe "Little Cut-Up" Saw

A GENERAL utility jig saw which cuts material up to 2 in. in thickness is now being manufactured and distributed by Beebe Bros., Inc., 3211 First Ave. S., Seattle, Wash. The table is 6 x 8 in. with a cutting clearance of 2 in. and a 32-in. swing.

Motive power is furnished by a 1/6-hp., single-phase, 60-cycle motor operating at 1,725 r.p.m. Accessories include a 6-ft. attachment cord with push switch and lamp socket plug-in. Four saw blades are furnished with each machine, one 1/8 in. wide, one $\frac{3}{16}$ in. wide, one 1¼ in. wide for wood, and one special



blade for metal cutting. The complete machine is 21 in. long, 14 in. high, and 6½ in. wide. It weighs 30 pounds.

Brunswick-Kroeschell, and York Heating and Ventilating Merge with Carrier Engineering

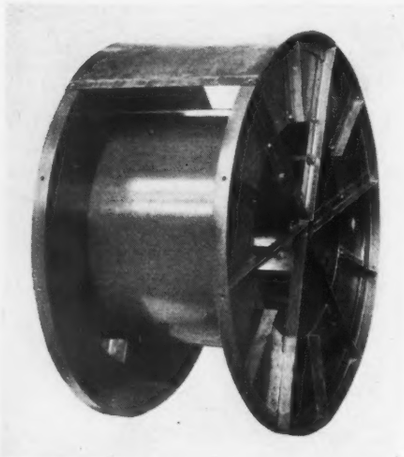
MERGER of the Carrier Engineering Corporation, Newark, N. J., Brunswick-Kroeschell Company, New Brunswick, N. J., and Chicago, Ill., and the York Heating and Ventilating Corporation, Philadelphia, Pa., concerns engaged in air-conditioning, refrigerating, and unit heating and ventilating fields respectively, has just been announced.

Including subsidiary and affiliated concerns, the merger unites fifteen companies, five of them foreign, to provide a single world-wide organization equipped to provide any desired kind of indoor atmospheric conditions.

According to the announcement, the merger plan contemplates that the fifteen companies involved will retain separate entities under a holding company to be known as the Carrier Corporation.

Truscon Steel Reels

STEEL reels for cable, wire, etc., which approximate the weight of corresponding wood reels, have been developed by the Pressed Steel Division,



Truscon Steel Company, Cleveland, O. Features of the reels include rigidity, strength, and low maintenance cost.

The reels have been designed with a view to allowing easy inspection, labeling, and spray painting. They can be stored either indoors or outdoors without changing weight owing to weather conditions. Steel or wood lagging can be supplied with them.

General Electric Motor for Hazardous Conditions

FAN-COOLED motors of the totally inclosed type for hazardous conditions, specified as Class 1 in the National Electrical Code, have been announced by the General Electric Company, Schenectady, N.Y. This line conforms, in most ratings, to the mounting dimensions of open, general purpose motors.

Polyphase induction motors at present embrace ratings from ¾ to 30 hp. in popular speeds and are especially designed for use in explosive gas conditions, Class 1, Group D, found in gasoline refineries, garages, chemical plants, paint factories, alcohol plants, and similar locations where the hazard is equal or less than that involved with high-test gasoline vapor-air mixtures. These motors are suitable for either indoor or outdoor operation and eliminate the necessity for fire walls and other protective equipment.

Totally inclosed, single-phase motors are now available in ratings of from ½ to 2 hp., and in fractional horsepower ratings of from ¼ to ½ hp., the latter either the repulsion-induction or d.c. type.

Delta-Star Disconnecting Switch Blade and Contact Unit

A DISCONNECTING switch blade and contact unit has been announced by the Delta-Star Electric Company, 2400 Block, Fulton St., Chicago, Ill., for mounting on various

forms of out-door type, high-tension switch insulator units.

Safety blocks are provided on the reinforced blade, the top contact of which has guides to insure proper blade closing. It is made in a wide range of current and voltage ratings.

Firestone Type "R" Truck Rim

FIRESTONE STEEL PRODUCTS COMPANY, Akron, Ohio, has developed the Type "R" truck rim which is a continuous-base rim with one side flange integral with the base and one continuous, removable side ring. An improved-type locking ring is riveted at one end to the removable side flange. The lock ring is always visible to the

operator when changing tires and is easily removed with a screw driver.

This rim is recommended for heavy-duty service.

Monitor Work-Cycle Timer

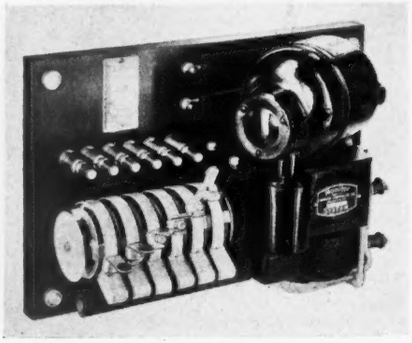
THE latest control device to be introduced by the Monitor Controller Company, Baltimore, Md., is the Monitor work-cycle timer, designed to meet the timing requirements of any electrically controlled work cycle.

The most important characteristic of the equipment is that it can be reset instantly at the starting point at any time during, or after, the completion of the cycle.

Current-carrying switches in a given timer unit are all electrically connected on the pivoted side. Each switch consists of a rotatable disk carrying an adjustable contact point and a post fixed on the panel, connected directly to the circuit to be controlled.

There are as many of these switches as there are circuits in the sequence. The rotatable disks are mounted loosely on a sleeve which is carried on a revolving hollow shaft, each disk being located between two rotating disks that are keyed to the shaft. These rotating disks are equipped with carbon blocks that bear against the switch disks.

The rotating hollow shaft is driven by a constant-speed electric motor. Through its center extends a clutch rod



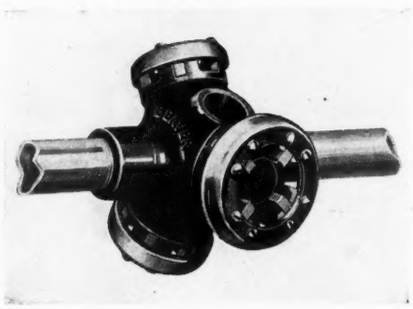
that can be moved by the action of a magnet. When the magnet is excited the clutch rod is pulled to the right and all the disks are pressed together, the pressure starting with the outside disk and passing through the whole line. Then the switches rotate, being driven through friction by the driving disks.

Rotation of each switch continues until it closes on its stationary contact post. From that time on, it simply slips between its driving disks.

When the magnet is released the pressure is removed from the disks and the reset weights cause all the switch disks to drop back to the normal rest position, ready to start again.

Borden Beaver Three-Way Die Stocks

SOME of the features of the three-way die stocks introduced by the Borden Company, Warren, Ohio, are: Electrically heat-treated die segments; large openings in the body for easy oiling and chip clearance; pressed-steel, die-retaining ring; extra-heavy and



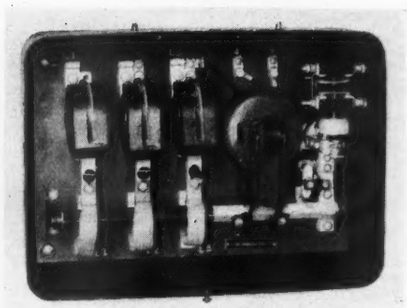
extra-long handle bosses; and light weight.

Dies and die-retaining rings are interchangeable with the No. 3 Beaver ratchet. They can also be inverted for threading short nipples, if desired.

General Electric Latched Switch

A MAGNETIC switch, known as CR-2811, for use on either a.c. or d.c. circuits, has been announced by the General Electric Company, Schenectady N. Y. The switch is provided with a latch which holds the contractor closed. Such a condition is desirable where the hum of a standard magnetic switch must be eliminated; where the power consumed to hold the contractor closed by the usual method must be eliminated because of cost; and where the switch must not open in case of coil failure, power failure, or short circuit.

This device consists of a two- or three-pole, a.c. contactor with a latching mechanism, mounted on a base, with or without an inclosing case. The contactor is standard except for an extension



of the shaft to which the latching mechanism is attached.

In operation, momentarily energizing the main contactor coil closes the contactor which is then latched closed. Momentarily energizing the trip coil trips the latch and opens the contactor. Either a single-pole, double-throw knife switch or a two-button, normally open, momentary contact-type push button may be used for this purpose.

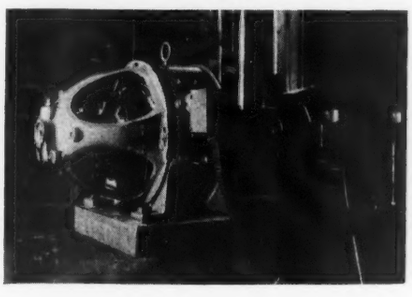
Melton Power Factor Control and Voltage Regulator

EVEN and uniform power factor can be maintained on any synchronous m.g. set by means of a power factor control developed by the Melton Control Company, Inc., Punxsutawney, Pa., according to a recent announcement. The power factor of the synchronous motor can be set at any desired point, where it will remain from no-load to 100 per cent overload by means of a separate exciter.

This exciter is direct connected to the main generator shaft, with the fields connected so that any change of the main generator load automatically increases or decreases the excitation of the synchronous motor.

To maintain a uniform power factor the excitation of the synchronous motor is varied from about 50 to 150 per cent of rated field current. This variable excitation limits the amount of wattless component furnished by the synchronous motor, which in turn permits the desired constant power factor.

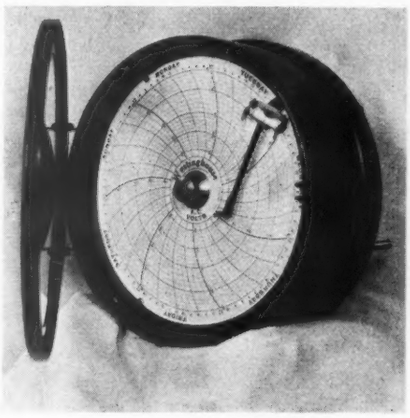
By maintaining a constant power factor, the a.c. voltage will be more stable. The control operates without relays, solenoids, or series torque motors with resistance. There are no contacts to burn, or unnecessary noises.



Westinghouse Recording Instruments

CIRCULAR-CHART recording instruments, identified as Type A, have been announced by the Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa. These instruments include ammeters and voltmeters and are made for switchboard mounting or for use as portable units.

They are designed principally for a.c. applications, but are also applicable to certain d.c. services. The ammeters are available in sizes ranging from 5 to 50 amp., and give a full-scale reading from zero to the value at which the meter is rated. Voltmeters are made in ratings varying from that which provides a scale of from 90 to 140 volts to that which records a maximum of 550 volts.



Three kinds of clocks for moving the circular chart are available — a key-wound, 8-day clock for driving the one-week charts; a key-wound, 36-hour clock for driving the one-day charts; and a sub-synchronous (self starting) motor-driven clock, operated by the system frequency. Gears are included to change synchronous-driven meters to other speeds.

Weil "Oscillator" Paint-Spraying Apparatus

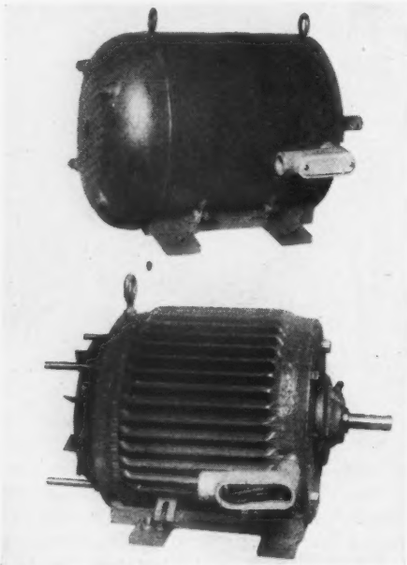
ALL oil and lead paints and lacquers can be sprayed by means of the "Oscillator" paint spraying equipment. This apparatus has been placed on the market by the Weil Machine Company, 2648 E. Fort St., Detroit, Mich. An even flow of air is furnished by the single piston which compresses air both on the upward and downward strokes. The bearings are adjustable and the piston is also adjustable in connection from the eccentric. The cylinder oscillates backward and forward.

The equipment consists of a motor mounted on the base with the compressor, an accumulator with a gage, and a vacuum-type spray gun and a paint container.

Lincoln Totally Inclosed Motor

A TOTALLY inclosed, fan-cooled, induction motor which embodies many improved features has been announced by The Lincoln Electric Company, Cleveland, Ohio. According to the announcement, this motor is designed so that its rise in temperature is considerably less than the allowable rise for motors of this type. The design also includes arc-welded steel construction, double-sealed ball bearings, and a removable cover which facilitates easy cleaning of the radiating surface.

Radiating surface is obtained by complete inclosure of the sides of the motor with a deeply corrugated sheet of corrosion-resisting metal. Heat created within the motor is thus conducted to its outer radiating surface which is cooled by a draft of fresh air. The air imprisoned within the sealed frame is

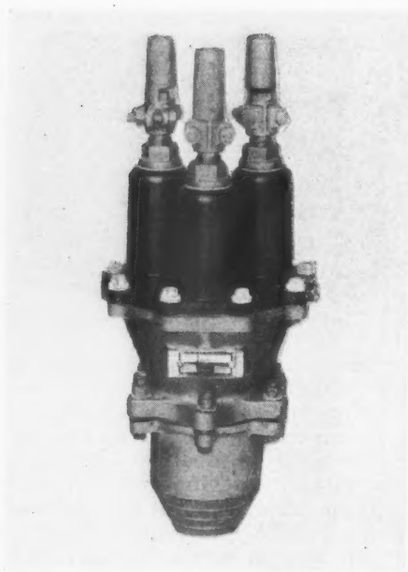


circulated by a fan welded to the rotor. The outside air which drives the heat from the radiating surface is forced over the exterior of the corrugated surface by a fan attached to the motor shaft.

This motor has the same mounting dimensions as standard, open-type horizontal motors of equal rating. Units are made in capacities of from 1 to 50 horsepower.

Delta-Star Three-Conductor Terminators

THREE-CONDUCTOR terminators for either compound or oil filling have been announced by the Delta-Star Electric Company, 2400 Block Fulton St., Chicago, Ill. They are vacuum tight, and, it is claimed, will withstand a hot-oil pressure of 50 lb. per sq. in. with oil at 180 deg. F. The main body is made of aluminum alloy. The top



element is made of molded insulation.

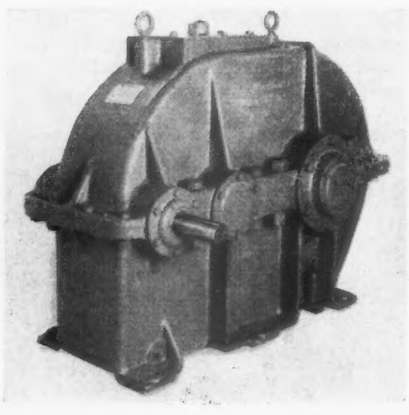
These units are made for voltages up to and including 7,500 volts and in current capacities up to 500 amperes.

Westinghouse-Nuttall SH and DH Speed Reducers

WESTINGHOUSE Electric and Manufacturing Company, East Pittsburgh, Pa., announces Types SH and DH Westinghouse-Nuttall speed reducers in standard, single- and double-reduction units for use in general industrial and mining operations. They are of the non-planetary design with shafts arranged in a horizontal plane, right- or left-hand assembly as desired.

Both types are made in twelve sizes providing a total of 28 standard reduction ratios ranging from 2.82:1 to 70.5:1, and having capacities of from 1 to 635 horsepower.

A single Timken bearing is used at each end of all high-speed and intermediate shafts. On low-speed shafts a Hyatt bearing is used at the extension end and a double Timken bearing at the closed end.



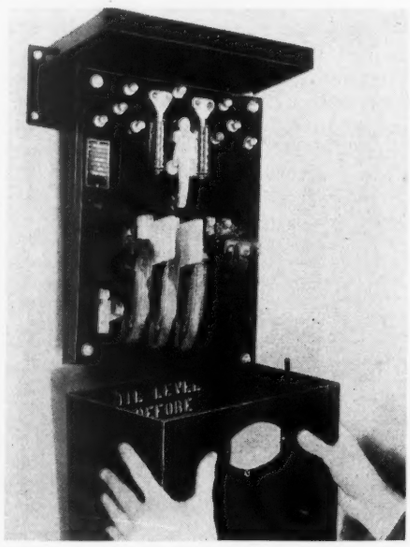
Lubrication of the gearing and bearings is supplied by a simple splash system, the bottom section of the case serving as the reservoir. A bayonet type oil gage is provided for checking the oil level.

Bedplates are of welded-steel construction, with or without supports for outboard bearings.

Monitor Thermaload Starter

IN its oil-immersed thermaload starter, the Monitor Controller Company, Baltimore, Md., has devised a control unit which gives across-the-line, full-voltage start with overload and low-voltage protection.

This starter consists of a standard Monitor magnetic contactor mounted on



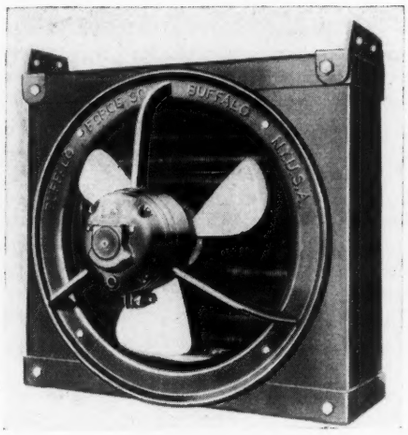
a panel with a thermal relay and inclosed in an oil-tight box. The oil level is such as to completely immerse the contactor and the contacts of the relay. Thermal elements are above the oil level.

In addition to the usual overload protection, the announcement states, this equipment will disconnect the motor if the voltage fails or drops excessively. Also, it will prevent damage to polyphase motors from running single-phase in case of phase failure.

Buffalo Model "B" Unit Heaters

IN the Model "B" Breezo-fin unit heaters which are now being made in eight sizes by the Buffalo Forge Company, Buffalo, N. Y., the casing is die-stamped and welded.

Clip hangers are furnished as standard equipment, which permit attachment to any two of the four corners, providing support for either platform,



side bracket, or top bracket suspension.

The fan is of die-stamped design. Discharge louvers are each separately adjustable to direct the air where desired.

The heating element, designated Aerofin, which is made of brass tubing and copper fin, is suitable for any steam pressure from 2 to 250 lb. per sq. in. The heating coils have been designed especially for Model "B" heaters with vertical supply on top and vertical drip at bottom.

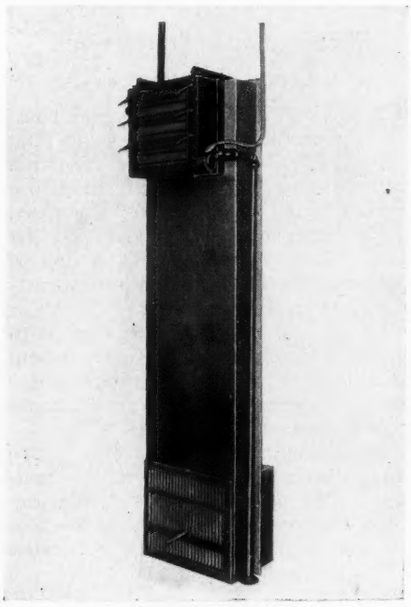
Fully inclosed motors are standard equipment, but constant-speed motors are available in single-phase, three-phase and d.c. types, if desired.

Wolverine Cabinet Unit Heater

A CABINET unit heater which provides an intake through the wall of the building as an alternate source of air, has been introduced by the Wolverine Tube Company, Detroit, Mich. A straight, square damper permits either one or both air inlets to be used at the same time. Summer ventilation with outside air is therefore possible, as well as winter ventilation with inside air.

Immediately above the air inlets is a steel-wool air filter which may be removed for cleaning.

A standard, Wolverine unit heater is used, which has an aeroplane-type fan, individually adjustable louvers, and an "off" and "on" switch. The cabinet has a flush, panel door through which the motor of the heater may be reached. Seamless copper tubing with copper fins runs in single lengths from multiple, bronze inlets to multiple, bronze outlets. There are no joints except the end connections, which are silver soldered. The tubing is arranged horizontally in non-abrasive saddles and at such an angle as to be self-draining. The unit is designed for use with hot water, vapor or steam.



Houghton Gear Lubricants

A SERIES of gear lubricants, known as Tenac No. 1, No. 2, No. 3 and No. 4, for all types of heavy, slow-moving, open gears, has been developed by E. F. Houghton & Company, Third, American and Somerset Sts., Philadelphia, Pa. According to the announcement, one of the features of this lubricant is that it will not be thrown off the gears while they are in motion. Tenac No. 1 is the heaviest lubricant of the series.

No special device or method of application is required.

Federal Cement Tile Acquires American Cement Tile Company

FEDERAL Cement Tile Company, Chicago, Ill., announces that it has acquired the American Cement Tile Manufacturing Company, with plants at Hammond, Ind., Lincoln, N. J., Wampum, Pa., and Birmingham, Ala.

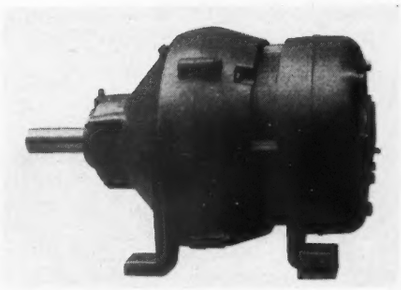
It is proposed to change the company name to the Federal-American Cement Tile Company.

Production Motorized Speed Reducers

MOTORIZED speed reducers in capacities up to and including 20 hp. are now being made by the Production Equipment Company, 5219 Windsor Ave., Cleveland, Ohio.

Units consist of a standard, heavy-duty electric motor with an integral planetary gear reduction unit mounted in an oil-tight housing.

All motors used in the units are built by the company and can be supplied in single-speed, multi-speed, inclosed, and high-torque designs for either horizontal or vertical mounting. The speed reducer provides a straight-line drive with final driving speeds as low as 50 to 550 revolutions per minute.

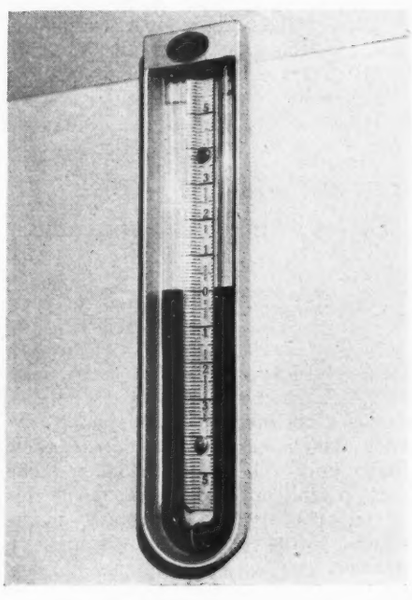


Arrow Flush Tumbler Switches

FLUSH tumbler switches, Nos. 1301 and 1303, have been announced by the Arrow Electric Division of the Arrow-Hart & Hegeman Electric Company, Hartford, Conn. Switch No. 1301 is a single-pole unit; No. 1303, a three-way unit. They are made for 10 amp., 125 volts; 5 amp., 250 volts.

Meriam "High Visibility" Manometers

MANOMETERS and flow meters, especially designed to permit easy reading at a distance, have been placed on the market by the Meriam Company, 1955 West 112th St., Cleveland, Ohio. The marked scale and the liquid used permits the instrument to be placed overhead or at a distance from the observer, without hindering the quick reading of pressure, the flow of air, gas or liquid measure.

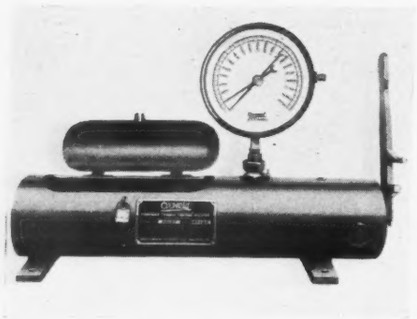


Oxweld Portable Weld-Testing Machine

OXWELD Acetylene Company, 30 East 42nd St., New York, N. Y., announces a portable, tensile-testing machine, designed to facilitate the testing of welds in the field or shop. It weighs 165 lb. and measures 28 in. in overall length and is 6¾ in. in diameter.

The machine consists of a tubular compression member with a set of grips in the head and a hydraulic cylinder block in its base. The cylinder block contains a communicating pump and cylinder machined into a single block. The cylinder pressure operates a piston carrying a second set of grips.

The specimen to be tested is placed between the jaws which have spring grips. The release valve is closed and the pump handle is moved back and forth. A set of conical blocks has also been constructed to fit into the machine head in place of the grips so that the



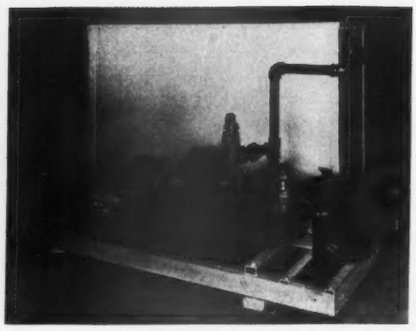
standard ½-in. round specimens may be tested if desired. The load is measured directly in pounds per square inch by means of a pressure gage.

General Electric Inside-Frosted Lamps

INSIDE-FROSTED lamps in 150-, 200-, 300-, and 500-watt sizes are now available, announces the General Electric Company, Schenectady, N. Y. These lamps supersede the outside-frosted lamps of the same wattages.

Despatch Finish Conditioning Equipment

EQUIPMENT for keeping all types of finishes clean and heated automatically has been introduced by the Despatch Oven Company, 622 Ninth St., S. E., Minneapolis, Minn. The system is a combination strainer and agitator which has been designed as a single unit. The finish is taken from the dip tank or flow-coating device by an electrically driven rotary pump which forces the finish through a strainer.



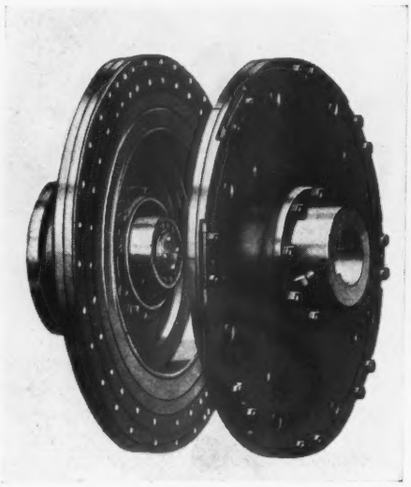
After the finish is thoroughly strained it is forced back into the dip tank or flow-coating device. This cycle is continuous. The equipment is arranged so that all of the finish in the tank is passed through the strainer once every five or ten minutes.

Cutler-Hammer Magnetic Clutches

A LINE of magnetic clutches which have been designated Type L because of the shape of the armature, has been introduced by Cutler-Hammer, Inc., 150 Twelfth St., Milwaukee, Wis. The cross section of the armature is L shaped to fit around the coil.

It is claimed that this shape gives a greater and steadier magnetic pull throughout the life of the lining. Also, the design provides for better operating characteristics, greater safety, and easier access to parts that may have to be renewed. Before the magnet coil is inserted in the field member it is wound on a sheet-metal form and vacuum impregnated. It is locked in place by means of four mounting studs which extend through the field casting. All coil terminals are recessed below the surface of the field member to protect them against damage.

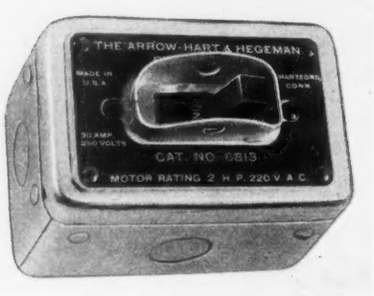
A centering bearing, which is a roller bearing mounted in the field member, and which protrudes so that it fits into a recess in the armature hub, forms a common support for both clutch members. It allows either member to revolve independently of the other when the clutch is disengaged, and assures perfect alignment and concentric engagement.



Collector rings are made of brass to prevent corrosion. They are mounted away from the hub on four insulated studs, so that it is almost impossible for sufficient dust to collect to cause creepage between them. Two carbon brushes are used on each ring, which insures that one brush is always in position to give good contact without arcing.

Hart & Hegeman Starting Switches

STARTING switches have been introduced by the Hart & Hegeman Division, The Arrow-Hart & Hegeman Electric Company, Hartford, Conn., for motors in capacities up to 2 hp. They were designed especially for normal- and high-torque, line start motors.



Units are available in double- and triple-pole types and furnished complete in cadmium-plated boxes with wiring knockouts. The handle is protected by a metal guard. The switch can be locked in the "on" or "off" position.

Westinghouse Starters and Speed Regulators

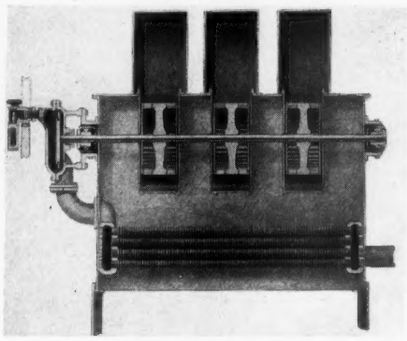
WHERE it is desired to have complete control of the primary and secondary of a wound-rotor induction motor in a single unit, the Westinghouse Electric and Manufacturing Company, E. Pittsburgh, Pa., has developed the Class 12-600 control panels, a line of manually operated, non-reversing starters and speed regulators.

These control panels are used with motors driving pumps, fans, cement mills, and similar applications where the infrequency of operation makes manual control desirable.

Dead-front, sheet-steel panels reduce the possibility of accident to the operator. The electric lockout device prevents the possibility of starting the motor unless all the secondary resistance is in the circuit.

Automatic Turbine-Driven Unit Heaters

TURBINE-DRIVEN unit heaters, known as Turbo heaters, are now being made by the Automatic Turbo Heater Company, 343 So. Dearborn



St., Chicago, Ill. These units are of a high-velocity, multi-fan type, designed for either high- or low-pressure heating systems, and for both floor and ceiling mounting. Shaft speed is 1,140 r.p.m. The turbine rotor is mounted directly on the blower shaft, eliminating the necessity of flexible couplings and turbine bearings.

Each unit is equipped with a thermostatically controlled valve. Steam from the main is led directly to the turbine inlet where a small portion of its heat is abstracted to develop the power to drive the fans. The steam is then exhausted to the coils where it is condensed.

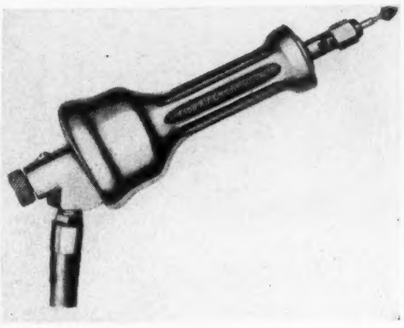
Coils are of copper with mechanically attached spiral fins. Fafner ball bearings are used.

Madison-Kipp Ball-Bearing Air Grinders

THE Madison-Kip Corporation, Madison, Wis., has announced the addition of three, ball-bearing, high-speed models to its line of air grinders.

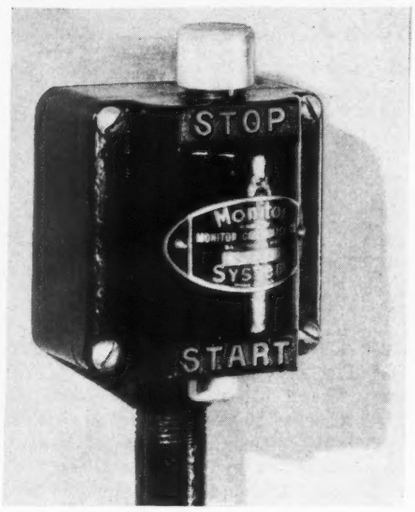
Model BBL is a low-pressure grinder designed to develop 60,000 r.p.m. on 30 to 50 lb. air pressure. Model BB operates at the same speed but requires pressures of from 50 to 100 lb. Model BB-100 requires 100 to 120 lb. pressure and operates at a speed of 100,000 r.p.m., it is stated. Ball bearings are used at both top and bottom in each of these units.

Lubrication is through the spindle which is hollow and cross-drilled with 1/32-in. holes. Oil is introduced at the end of the hollow spindle by means of a syringe oiler; centrifugal force delivers it to the bearings through the holes in the spindle.



Monitor "Ironclad" Push Button Switch

FOR momentary contact control especially suited for machine service, the Monitor Controller Company, Baltimore, Md., has designed the "Ironclad"



push button switch for a.c. or d.c. circuits.

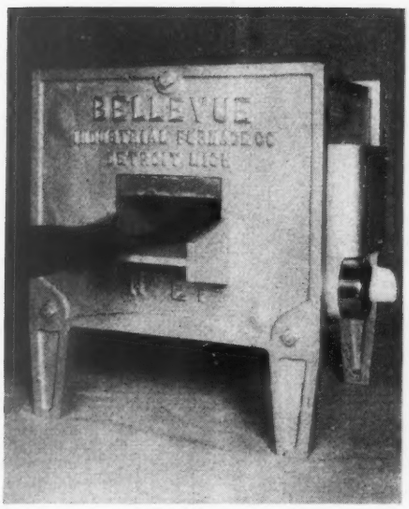
Features claimed for this switch include quick-action inching, and flexible contacts. The stop button is on top, fully exposed and easy to operate, while the start button is fully protected from accidental contact.

Construction consists of two parts; the base which carries the wiring and fixed contacts, and the cover carrying the buttons. Conduit connections can be made from top, bottom, or either side.

Overall dimensions are: height, 4¼ in.; width, 2 15/16 in.; depth from mount, 2⅝ inches.

Bellevue Electric Solder-Iron Heater

ELECTRIC solder-iron heaters adapted for maintenance work, where gas is objectionable or not available, are being marketed by the Bellevue Industrial Furnace Company, 2971 Bellevue Ave., Detroit, Mich. Over-all dimensions are 15½ in. wide, 13¾ in. high, and 13¾ in. deep. Openings are 4½ in wide and 1¾ in. high. The chamber is 5 in. deep.

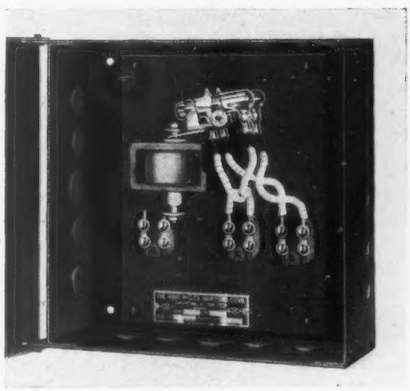


"Globar" cartridge-type heating elements are replaceable while the furnace is at maximum temperature. The heater also can be used for annealing and hardening small parts.

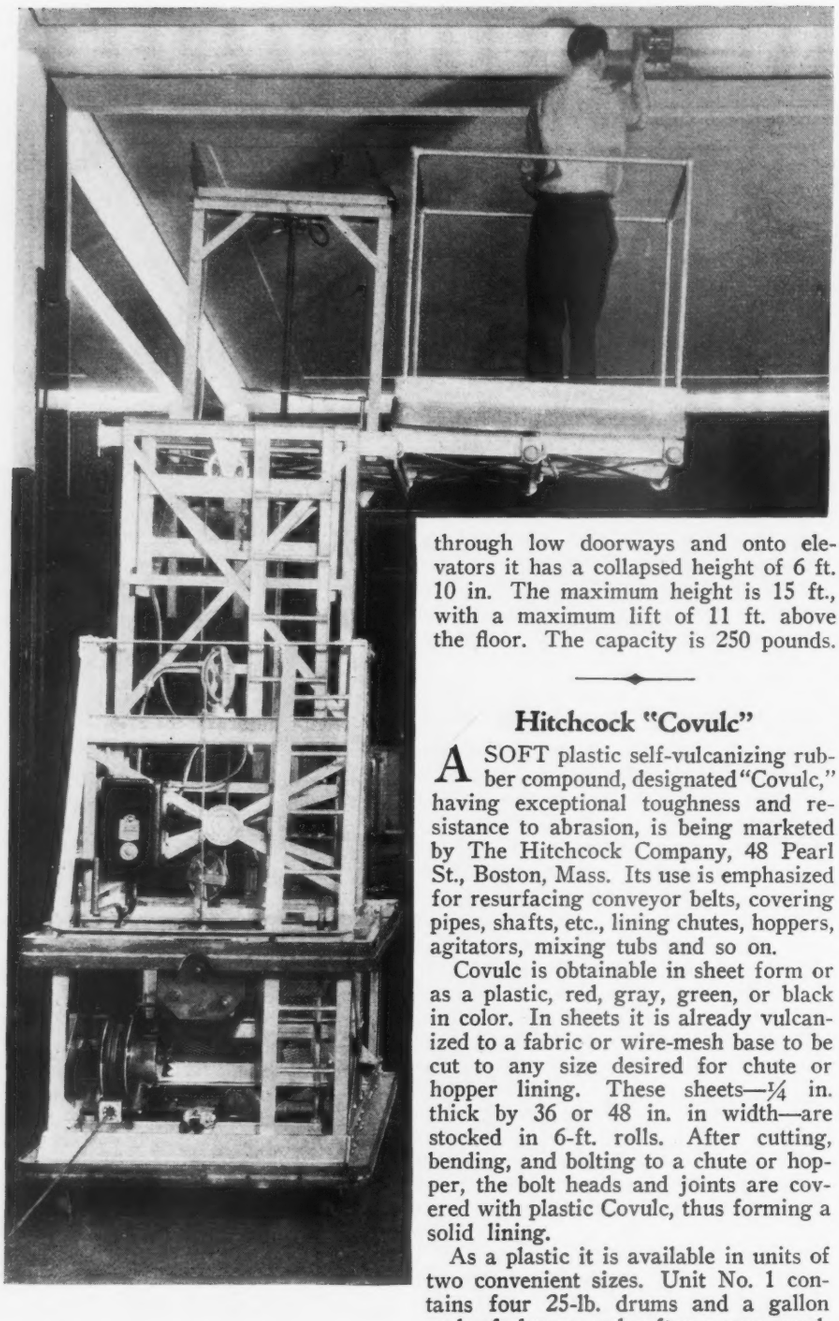
Hart Mercury Tube Relay

RELAYS, designed for controlling loads up to 25 amp. at 125 volts by means of a low-amperage secondary circuit, have been introduced by the Hart Manufacturing Company, Hartford, Conn. The a.c. coils are of the continuous-current type and are wound for 110 or 220 volts. Coils for d.c. service, also special d.c., low-voltage coils for voltages as low as 6 volts, can be supplied.

These relays may be used for controlling automatic machines, signal systems, and temperature control on all kinds of industrial equipment. They are made in single-, double-, triple-, and four-pole combinations and in single-pole, double-throw, and double-pole, double-throw types.



Solenoid windings are designed for continuous operation and can be controlled by any suitable single-pole switch. Standard Type A or flush metal boxes are furnished.



Economy Telescopic Lift Truck

A TELESCOPIC lift truck designed primarily for cleaning work has been made by the Economy Engineering Company, 2635 West Van Buren St., Chicago, Ill. The machine is, in effect, a one-man cleaning outfit. It is self propelled, taking its power from an ordinary light socket, and may be steered from the platform in an elevated position, anywhere within the 75-ft. radius allowed by the conductor cable. In addition to the self-propelling feature, the platform, which is 4 ft. wide, may be telescoped laterally 4 ft. on either side to clear machines and other obstructions.

To enable the machine to be moved through low doorways and onto elevators it has a collapsed height of 6 ft. 10 in. The maximum height is 15 ft., with a maximum lift of 11 ft. above the floor. The capacity is 250 pounds.

Hitchcock "Covulc"

A SOFT plastic self-vulcanizing rubber compound, designated "Covulc," having exceptional toughness and resistance to abrasion, is being marketed by The Hitchcock Company, 48 Pearl St., Boston, Mass. Its use is emphasized for resurfacing conveyor belts, covering pipes, shafts, etc., lining chutes, hoppers, agitators, mixing tubs and so on.

Covulc is obtainable in sheet form or as a plastic, red, gray, green, or black in color. In sheets it is already vulcanized to a fabric or wire-mesh base to be cut to any size desired for chute or hopper lining. These sheets—¼ in. thick by 36 or 48 in. in width—are stocked in 6-ft. rolls. After cutting, bending, and bolting to a chute or hopper, the bolt heads and joints are covered with plastic Covulc, thus forming a solid lining.

As a plastic it is available in units of two convenient sizes. Unit No. 1 contains four 25-lb. drums and a gallon each of cleaner and softener compound, and rubber solution, sufficient to repair approximately 300 ft. of 24-in. conveyor belt if badly worn. Unit No. 2 comprises just half the quantity listed. A spatula, a wire brush, and a glass roller for its application are included in each unit.

Applied in the form of a thick paste, it rapidly vulcanizes when exposed to air, forming a permanent rubber covering on any surface to which it is attached.

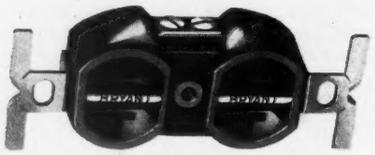
General Electric Motor Lubricant

A GREASE for ball and roller bearing motors has been announced by the General Electric Company, Schenectady, N. Y. This lubricant, the announcement states, is being used successfully on ball bearing applications with speeds as high as 25,000 r.p.m. and temperature exposures from minus 25 to 250 degrees F. However, its use is recommended only for the lubrication of motor bearings where the motors were originally grease lubricated.

Lubricant is supplied in 2-oz. tubes, and 1-lb. cans. A tabulation appearing on the instruction sheet accompanying the two-ounce tube denotes the amount of grease to be used in the various motors by frame sizes.

Bryant Duplex Flush Receptacle

DUPLEX receptacle No. 4832 is being marketed by The Bryant Electric Company, Bridgeport, Conn. The body is of brown Bakelite. The base is 2 21/32 in. long, 1½ in wide, and 23/32 in. deep. Supporting screw



spacing is 3 9/32 in. The plate-mounting screw is grounded to the yoke. Each side-wiring terminal has two No. 8 binding screws.

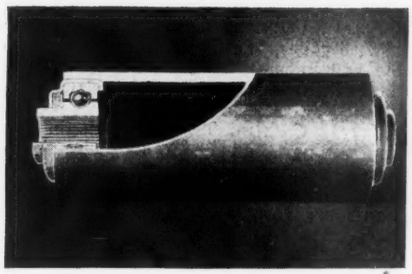
Armstrong-Bray "Steelgrip Universal" Gear and Wheel Puller

ARMSTRONG-BRAY & Company, 666 Eagle St., Chicago, Ill., introduces the "Steelgrip Universal" gear and wheel puller which consists essentially of three chains, each 3 ft. long; hooks for attaching to wheel spokes; a puller frame, and a chrome-nickel steel screw, hardened at the point. The pulling power of this device is approximately four tons.

Longer chains can be furnished, if desired.

Mathews Roller Conveyor

A HEAVY-DUTY roller conveyor, especially designed and constructed for use in plants where extremely heavy service is encountered, has been announced by the Mathews Conveyor



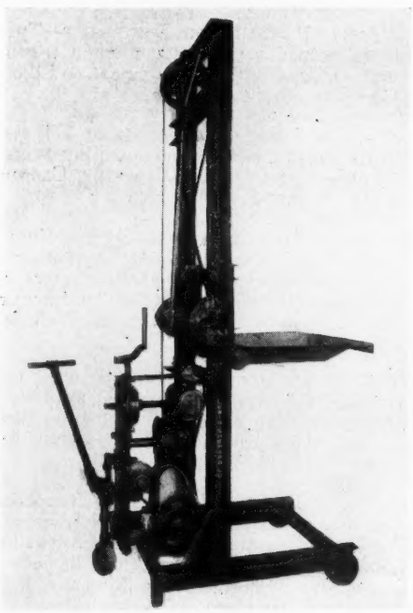
Company, Ellwood City, Pa. Featured in this model is a gearlock, made possible through gear teeth on the cone and knurling on the axle of the conveyor. This lock eliminates the turning of the bearing on the axle.

Clogging of the conveyor is eliminated by protecting all bearings with a steel and felt washer labyrinth which excludes dust, grit, and so on. Bearings can be packed with grease or furnished with lubrication fittings if heavy-duty service is anticipated.

Another feature is the keylock axle. One end of the axle is provided with an upset key, fitting into a corresponding slot in the frame rail, which prevents the axle from turning. The opposite end of the axle has a standard, cotter key-lock.

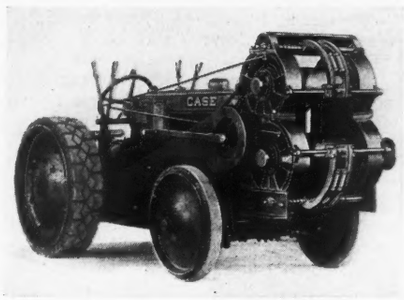
Lewis-Shepard Stacker

THE Lewis-Shepard Company, Watertown Station, Boston, Mass., has added a combination gas-engine-driven and hand-power stacker to its line of lifting equipment. This unit is operated by a 2½- to 3-hp., air-cooled, four-cycle engine and will lift a 1,000-lb. load at the rate of 40 f.p.m. Lowering is accomplished by means of a decelerator control which prevents excessive over-speeding.



Trackson "HC" Hoist

A PORTABLE hoist, known as the "HC," adapted for mounting on Case Model CI industrial tractors, has been announced by the Trackson Company, 500 Clinton St., Milwaukee, Wis. Some of the features claimed for this unit are: over-sized drum shafts, stronger frames, improved clutches, and the patented level wind which prevents



the cable from criss-crossing and bunching. All controls are within easy reach of the operator.

This unit can be obtained in either single- or double-drum types and can be converted from one to the other by mounting or detaching the upper drum.

General Electric Heavy-Duty Magnetic Switches

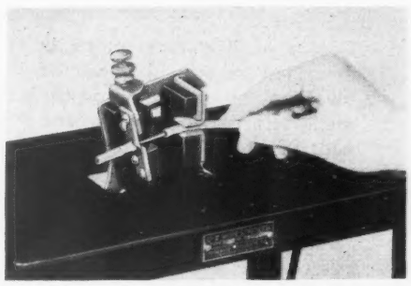
OIL-IMMERSED magnetic switches, bearing the designation CR-7006-T-5, for heavy-current duty in controlling large motors, have been announced by the General Electric Company, Schenectady, N. Y. These switches supersede the CR-7006-T-3, 150-amp. unit, and consist of a three-pole, 200-amp., oil-immersed contactor, a temperature overload relay, two current transformers, and an undervoltage relay, all mounted on a suitable floor-mounted framework which is built with a steel front.

Instantaneous undervoltage protection is obtained with one form when used with a drum switch. Time delay undervoltage protection is obtained with the other form when used with momentary-contact type pushbutton control.

For standard motors, the switches are rated 750 hp. at 2,500 volts, and 1,200 hp. at 4,000 volts. They have an approximate weight of 526 lb. and require 5½ gal. of oil each.

Ideal "E-Z" Pedestal-Type Wire Stripper

A WIRE stripper of the pedestal type, bearing the designation "E-Z", has been introduced by the Ideal Commutator Dresser Company, Sycamore,



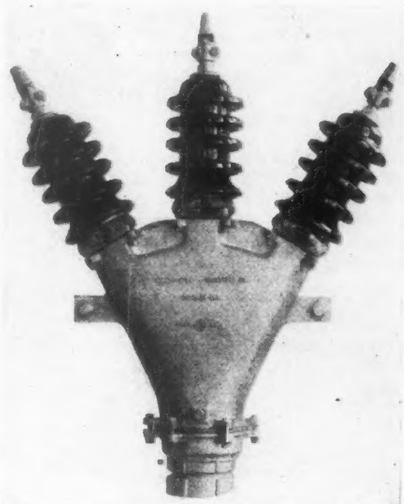
Ill. The machine will strip stranded, solid-core or parallel cord with a single pedal movement. Interchangeable blades of the shearing type with a single V notch for single conductor or a double notch for duplex cord are used. The size of the stripping hole in the blades may be increased or decreased by means of a micrometer screw adjustment.

A floor space of 18x18 in. is required. It weighs 25 pounds.

Delta-Star Three-Conductor Terminators

UNIT-TYPE, three-conductor terminators with porcelain bushings, designed so that they interchange on each phase and also with the bushings of single-conductor terminators, have been introduced by the Delta-Star Electric Company, 2400 Block, Fulton St., Chicago, Ill. The body is of cast, nonmagnetic aluminum alloy and is nonrusting. Flashover values are 100 kv. dry, and 85 kv. wet.

These units are oil, vacuum, and water tight and are suitable for oil or compound filling.



TRADE LITERATURE

You Should Know About

Copies of literature which is described on this page can be obtained by writing to the manufacturer whose name and address are mentioned. It is always advisable to state the name and number of bulletin or catalog described, as given in these columns.

* * *

(323) BELTING — Catalog, 12 pages; belting, packing, hose, matting, and miscellaneous items.—Diamond Rubber Company, Inc., Akron, Ohio.

(324) BALL BEARINGS—Data book, 7th edition, 62 pages; ball bearing information.—The New Departure Manufacturing Company, Bristol, Conn.

(325) INSULATION—Folder, "Keldur" for eliminating vibration, noises, and shock.—International Products Corporation, 733 North Van Buren St., Milwaukee, Wis.

(326) V-BELTS — Bulletin L-400 B-1, Multi-V-Drives for power transmission. —Worthington Pump and Machinery Corporation, 2 Park Ave., New York, N. Y.

(327) POWER TRANSMISSION — Catalog 10, 12 pages; self-aligning, roller-bearing units.—Shafer Bearing Corporation, 6501 West Grand Ave., Chicago, Ill.

(328) FIRST AID—Catalog FA-2, M. S. A. first-aid material.—The Mine Safety Appliances Company, Pittsburgh, Pa.

(329) PLATING EQUIPMENT — Bulletin, "Full-Automatic, Straight-A-Way and Return-Type Plating Machines." — The Meaker Company, Chicago, Ill.

(330) POWER TRANSMISSION —Folder, speed reducers, cut gears, V-belt sheaves, flexible couplings.—W. A. Jones Foundry & Machine Company, 4417 Roosevelt Road, Chicago, Ill.

(331) AIR CONDITIONING EQUIPMENT—Brochure, "An Air Castle," a brief sketch of the founding and history of the company from 1864 up to the present time.—B. F. Sturtevant Company, Hyde Park, Boston, Mass.

(332) CHAIN — Data book 1050, 32 pages; Promal chains.—Link-Belt Company, 910 South Michigan Ave., Chicago, Ill.

(333) MOTORS—Bulletin 109, Type AA induction motors with ball bearings.—Reliance Electric & Engineering Company, Ivanhoe Road, Cleveland, Ohio.

(334) SPEED REDUCERS—Bulletin 230, 68 pages; parallel-shaft speed reducers. —The Falk Corporation, Milwaukee, Wis.

(335) OVENS — Bulletin 11, conveyor ovens.—Despatch Oven Company, 622 Ninth St., S. E., Minneapolis, Minn.

(336) LIGHTING—Catalog 900, 54 pages; porcelain enamel, and aluminum reflectors, and fittings for industrial applications. — Ivanhoe Division of The Miller Company, Meriden, Conn.

(337) STANDARDS — A 4-page folder listing publications on approved American engineering and industrial standards. —American Standards Association, 29 West 39th St., New York, N. Y.

(338) CONVEYOR OVENS—Bulletin 12, 4 pages, elevated- and tunnel-type conveyor ovens for baking and drying processes.—Despatch Oven Company, 622 9th St. S.E., Minneapolis, Minn.

(339) TERMINATORS — Bulletin 65-B, terminators for sealing ends of high-voltage cables.—Delta-Star Electric Company, 2400 Block, Fulton St., Chicago, Ill.

Coming Events

American Institute of Electrical Engineers—Annual winter convention, New York City, Jan. 26-30, 1931. Secretary, F. L. Hutchinson, 33 W. 39th St., New York, N. Y.

Fifth Midwest Engineering and Power Exposition—Coliseum, Chicago, Feb. 10 to 13, 1931. Managers, Midwest Engineering Exposition, Inc., 308 W. Washington St., Chicago, Ill.

Second National Western Metal Congress and Exposition—Civic Auditorium, San Francisco, Calif., Feb. 16-20, 1931. Under auspices of A.S.S.T. W. H. Eisenman, secretary, 7016 Euclid Ave., Cleveland, Ohio.

Second National Industrial Congress Featuring Management, Maintenance and Materials Handling—Public Auditorium, Cleveland, Ohio, April 13 to 18, 1931, inc. In conjunction, Second National Industrial Equipment Exposition. Concerning technical sessions address P. T. Wetter, American Society of Mechanical Engineers, 29 West 39th St., New York City. Exposition under management Midwestern Engineering Exposition. 308 West Washington St., Chicago, Ill.

National Fire Protection Association—35th annual meeting, Toronto, Can., May 11 to 17, 1931. Association headquarters, 60 Batterymarch St., Boston, Mass.

National Electric Light Association—54th convention and exhibition, Municipal Auditorium, Atlantic City, N. J., June 8 to 12, 1931. Frank H. Gale, Secretary-Treasurer, 420 Lexington Ave., New York, N. Y.

(340) CONTROLS — Publication GEA-727B, hesitating-control relays for d.c. circuits.—General Electric Company, Schenectady, N. Y.

(341) MATERIALS HANDLING—Bulletin, 40 pages, Lansing wheels and casters for hand trucks.—Lansing Company, Lansing, Mich.

(342) FLEXIBLE COUPLINGS — Circular 1887, 8 pages, Westinghouse-Nuttall flexible couplings.—Westinghouse Electric & Manufacturing Company, E. Pittsburgh, Pa.

(343) COATING TANKS — Bulletin 200, superseding Bulletin 160, electrically heated, vertical, coating tanks for asphalts, tars, oils, and similar substances.—H. O. Swoboda, Inc., 3400 Forbes St.., Pittsburgh, Pa.

(344) ROTORS — Bulletin 200, 8 pages, "Ideal," unit-type, induction motors.—The Ideal Electric & Manufacturing Company, Mansfield, Ohio.

(345) SWITCHBOARD INSTRUMENTS—Catalog 48, 44 pages, a.c. and d.c. instruments, swinging brackets, multipliers, and other accessories. — Roller-Smith Company, 233 Broadway, New York, N. Y.

(346) PIPE MACHINES — Bulletin C-63, stationary pipe, casing, drill pipe, line pipe and tubing die heads. — Landis Machine Company, Waynesboro, Pa.

(347) SPEED REDUCERS—Circular 1891, Westinghouse-Nuttall speed reducers Types SVR, DVR, and DVRA.—Westinghouse Electric & Manufacturing Company, E. Pittsburgh, Pa.

(348) MOTORS—Data Book Section 202, Type RA repulsion-induction, single-phase motors, 1/30 to 5 hp.—The Master Electric Company, Dayton, Ohio.

(349) PYROMETERS — Catalog 15A, 100 pages, indicating, recording, and controlling pyrometers for measuring temperatures up to 3,000 deg. F.—The Brown Instrument Company, Philadelphia, Pa.

(350) ELECTRODES — Booklet GEC-93, welding electrodes. — General Electric Company, Schenectady, N. Y.

(351) POWER PLANT EQUIPMENT—Turbines, reduction gears, steam engines, generators, and other equipment. — Elliott Company, Pittsburgh, Pa.

(352) SWITCHES—Catalog 100, test switches, test blocks, and metering accessories.—Meter Devices Company, Canton, Ohio.

(353) STEEL PRODUCTS—Buyers Guide, Fall Issue, 1930. A directory of manufacturers, fabricators, and distributors of nickel-alloy steel products.—The International Nickel Company, Inc., 67 Wall St., New York, N. Y.

(354) MOLDING MATERIAL—Booklet "Lumarith," physical and chemical characteristics, molding equipment and procedure. —Celluloid Corporation, 10 East 40th St., New York, N. Y.

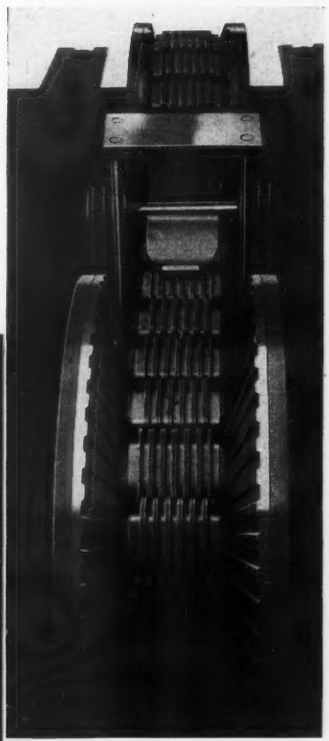
(355) FUSES—"Fuseology, A Handbook on Fuses," 20 pages, history of fuses and a detailed description of the construction and proper application of these devices.—Bussmann Manufacturing Company, University at Jefferson, St. Louis, Mo.

An INNOVATION *in* *Variable Speed Transmission*

For more than three years Link-Belt has been testing in practical service an entirely new type of variable speed transmission, the P. I. V. Gear. It is now on the market, and becomes a new unit in Link-Belt's comprehensive line of Positive Drives.

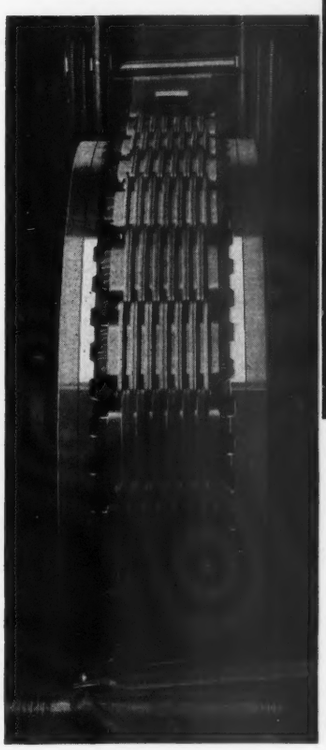
The Link-Belt P. I. V. Gear is unique in that it is the first variable speed device in which the power is transmitted from the input to the output shaft through a positive chain drive.

Link-Belt now builds the P. I. V. Gear in five standard sizes, from 1 to 10 H. P. capacity, providing speed change ratios up to a maximum of 6 to 1. Full details are in new book No. 1274.



Right: *Tooth formation of the* **P. I. V.** *Chain on the minimum diameter of a wheel (a pair of discs).*

Lower: *Tooth formation of the* **P. I. V.** *Chain on the maximum diameter of a wheel (a pair of discs).*



LINK-BELT COMPANY

Leading Manufacturers of Positive Power Transmitting Equipment

CHICAGO, 300 W. Pershing Rd. INDIANAPOLIS, 501 N. Holmes Ave.
PHILADELPHIA, 2045 W. Hunting Park Avenue
Offices in Principal Cities

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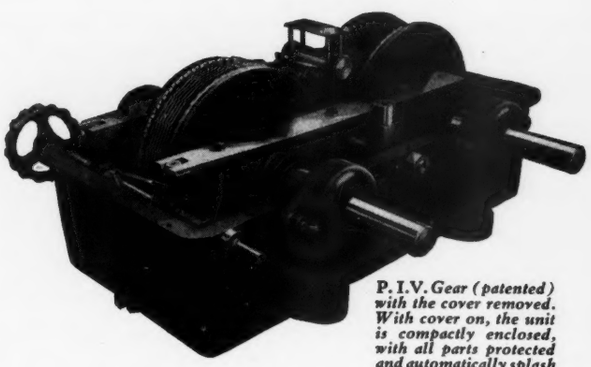

P. I. V. Gear (patented) with the cover removed. With cover on, the unit is compactly enclosed, with all parts protected and automatically splash lubricated.

Link-Belt makes a Positive Drive for every class of power transmission service. These drives include:

Silent Chain Drives
Roller Chain Drives
Herringbone Gear Speed Reducers
Herringbone Gears
Worm Gear Speed Reducers
Malleable Iron and Steel Chain Drives
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THE LINK-BELT P.I.V. GEAR

• • POSITIVE INFINITELY VARIABLE • •

See the P. I. V. Gear at our Exhibit at the Chicago Power Show, Feb. 10 to 14, 1931

Where the mercury drops out of the bulb the Colt stands for law and order

What a wealth of romance clings about the activities of the famous Royal Canadian Northwest Mounted Police! The United States Cavalry had their task cut out for them when subduing the American Indian, and away up North in the land of no shelter the Mounties shouldered the rebellion of the half-breeds on the North Saskatchewan under Louis Riel and Great Bear, in 1869. Out of sight from civilization, over white desolate wastes and facing nature at her cruellest, the Colt, to the Canadian Mounted, often proved his only friend.

On sun-baked prairie and snow-swept slope, Colt has always stood for protection—still available. And today, another form of Colt protection is safeguarding electrical equipment through the NOARK line of safety switches and meter protective devices — for over seven years Colt made. The fine degree of mechanical precision so typical of Colt is clearly seen in the Colt-Noark line. Watch-like methods of accuracy are stamping NOARK products as true members of the Colt family. NOARK products need no introduction to users of electrical equipment, for NOARK is an old and honored name. Its association with Colt assures added progress and protection.

COLT
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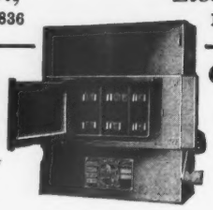
COLT'S PATENT FIRE ARMS MFG. CO.,
Established 1836

***Electrical Division*, HARTFORD, CONN., U.S.A.**
Electrical Division 1886

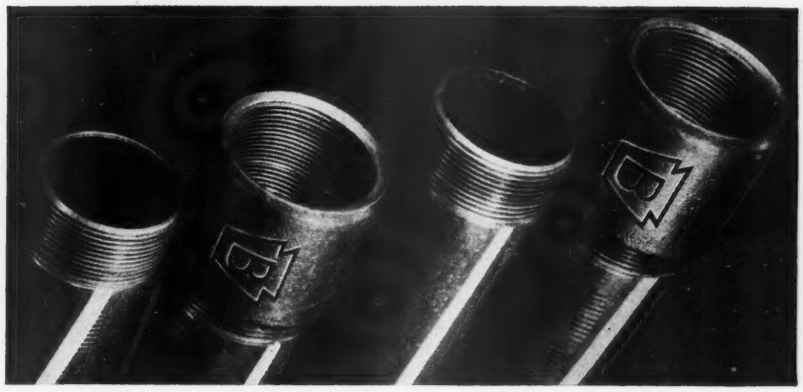
WHERE MAINTENANCE CONDITIONS ARE SEVERE

In steel mills, mines, paper mills, chemical plants, and other places where operating conditions are ruinous to ordinary switches, Colt-Noark Quadbreak is standing up.



Send for Catalog "D" and detailed description. "The Rampant Colt," an interesting publication, mailed on request.

"PIPE



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BYERS GENUINE WROUGHT-IRON PIPE

HAS IMPORTANT PLACE IN ANY SPECIFICATION THAT "FITS THE FIELD"

INCREASING interest in the qualities of wrought-iron is creating new fields of service for Byers Genuine Wrought-Iron Pipe. In this age of specialization, "pipe prescription" is determining the type of pipe for the type of problem. In the place where its superiority is established by actual service on a cost-per-year basis, substitution of either cheaper or more expensive pipe is not true economy. Initial cost alone does not determine cost-per-year of service. Byers Genuine Wrought-Iron Pipe is a standard of wrought-iron quality. May we tell you about Byers Genuine Wrought-Iron Pipe and suggest its economical uses to you? Look for the Spiral Stripe! Write to us. A. M. Byers Company, Pittsburgh, Pa. Established 1864.

BYERS • GENUINE • WROUGHT-IRON PIPE

AN INVESTMENT—NOT AN OUTLAY

WINNERS

The airplanes manufactured by the Heath Aircraft Corporation of Chicago are built to stand the gaff of high speed and long flying periods and they have made good during the entire 20 years in which they have been on the market.

The lightest flying boat ever produced was built and flown by Mr. Heath in 1913.

And from this time on, the Heath planes, in competition at notable air races have made a record which justifies giving them the title of WINNERS.

The beautiful trophy won by a Heath "Super Parasol" at the National Air Race in 1927 is but one of many awards which testify to the superiority of these planes.

Recently, the Heath engineers overhauled a motor which had done three hundred hours' service and the CJB Bearings used in it were in such good condition that after a thorough cleaning and relubricating they were put back in the motor. The strain these bearings have to stand will be realized from the fact that they are used in front of the crankshaft and take on the thrust of the plane as well as the high speed of the motor operating about 3300 RPM.

Whether it's airplanes, motor trucks, printing presses, dynamos, or any other type of machine in which ball bearings are used, CJB Bearings will conquer friction — the robber of power, speed and smooth operation. Thev also are WINNERS.

CJB Ball Bearings are what might be called "seasoned performers". For 20 years, our only business has been in the making of bearings and when an organization of picked men has been on one job for that length of time, it's a pretty certain thing that they know how to get results.

We have studied and tested thousands of ball bearings of every type, size and manufacture, grading and classifying them, so that we know just what a bearing must be to stand up under heavy loads and high speeds. And all this experience is embodied in CJB Bearings.

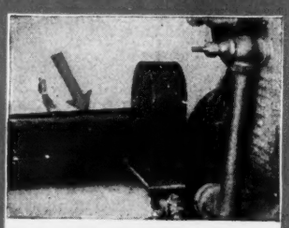
If you have any problem regarding the proper bearings to use, our experts will be glad to discuss it with you and to give you the benefit of their experience.

Send for our descriptive literature on CJB Bearings.

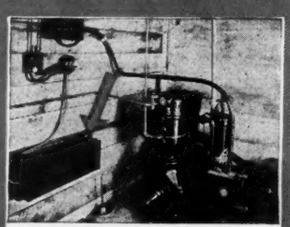
Ahlberg Bearing Company, 321 East 29th St., Chicago, Illinois. Branches in principal cities.

The Answer to your cold weather heating jobs...

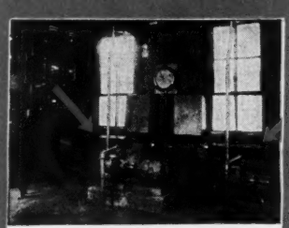
In Crane Cabs



Protecting Sprinkler Valves



Keeping Pumps Working



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No obligation

ELECTRIC AIR HEATERS

Easily and Quickly Installed Anywhere! 45 Sizes and Ratings. Three Types—Horizontal, Vertical, and Portable. 1000, 1500, 2000, 3000 watts. 110, 220, 250, 440, 550 volts. Completely assembled with 3-ft. armored cable and 3-heat switch; or Automatic Control, extra. Always ready. End complaints about "there isn't any heat." 20% more heat. All heat is utilized for air heating! NO FIRE HAZARD. Temperature between heater case and wall kept far below fire hazard point. Built to last. Hundreds in use. Same type heaters used on 230 railways. Use coupon below.

STRIP AND SPACE HEATERS

80 sizes of Strip Heaters, 8" to 72" long. For all kinds of heating jobs. Heating ovens and tanks; keeping pipe lines from freezing; melting anything from metal to grease; heating machines, equipment, special processes; preheating fuel oil. Also used as resistance to take up induction kicks. Hundreds of companies are saving time and money on their heating jobs by switching over to Chromalox heaters. Whether yours is a big job or a small one . . . low temperature or one that runs up to 1100 degrees F., tell us about it when you send for your copy of C-108-A. No obligation!

**Tear Off and Mail with Your Letterhead*

Memo to Edwin L. Wiegand Company, 7518 Thomas Blvd., Pittsburgh, Pa.

Yes, we need more heat around here. Without obligation, send Bulletin C-108-A and please tell us right away how to properly heat a space used for:

.....

which is.....ft. long.....ft. wide.....ft. high

having.....windows.....doors

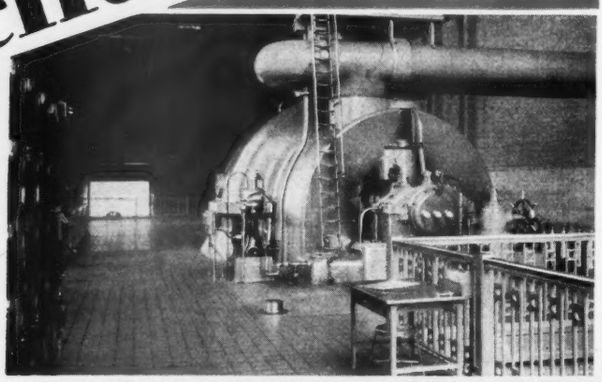
Signed.....Position.....

Company.....Address.....

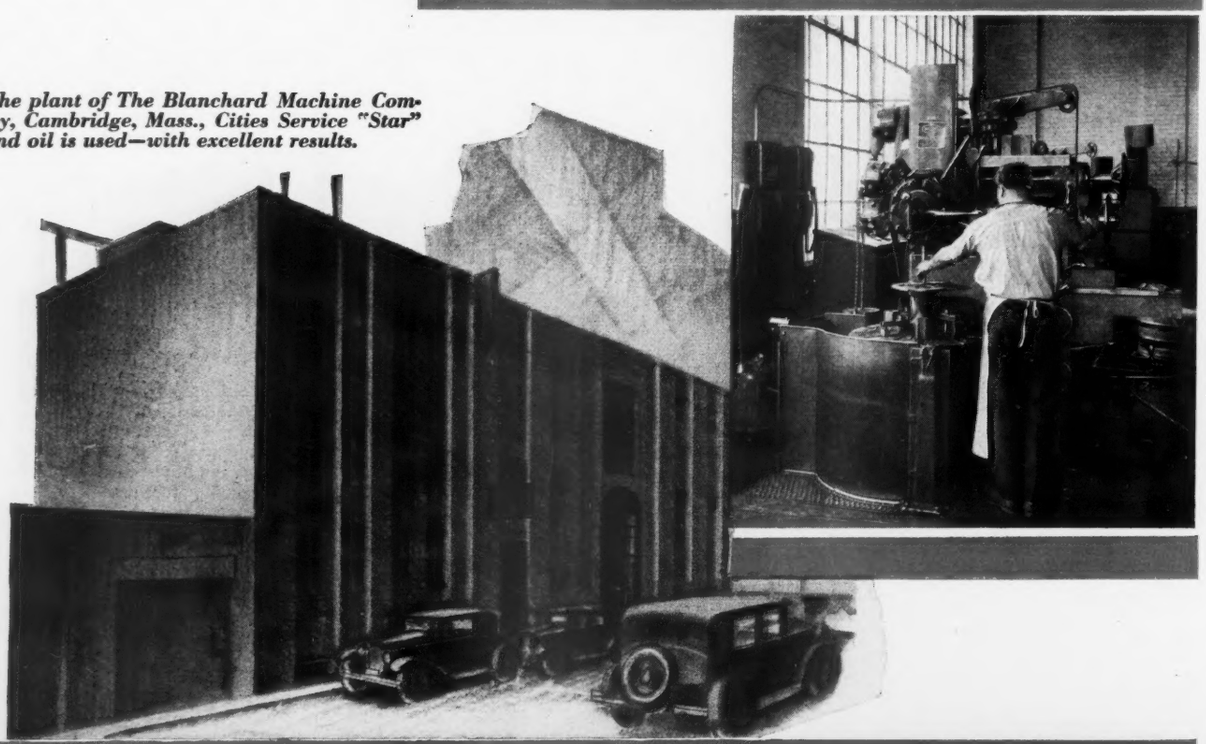
1 E 12-30

The station of the Stanton Operating Co., Pittston, Pa., where, for 3½ years, the turbines, pumps and motors have been lubricated by Cities Service Light Sentry.

From Central Stations



In the plant of The Blanchard Machine Company, Cambridge, Mass., Cities Service "Star" brand oil is used—with excellent results.



CITIES SERVICE

QUALITY PROVED WHERE IT SHOULD

to Machine Shops...
CITIES SERVICE Lubricants

In central stations, machine shops, printing establishments, manufacturing plants in general—wherever moving parts must be lubricated—you will find Cities Service lubricants helping maintenance men to cut operating costs, prevent waste, and avoid interruptions due to breakdowns.

Maintenance men everywhere have complete confidence in Cities Service Oils and Greases. They know that Cities Service products are produced, refined and marketed by a billion dollar organization which operates as a complete petroleum unit and spends a million dollars each year to improve its products and services.

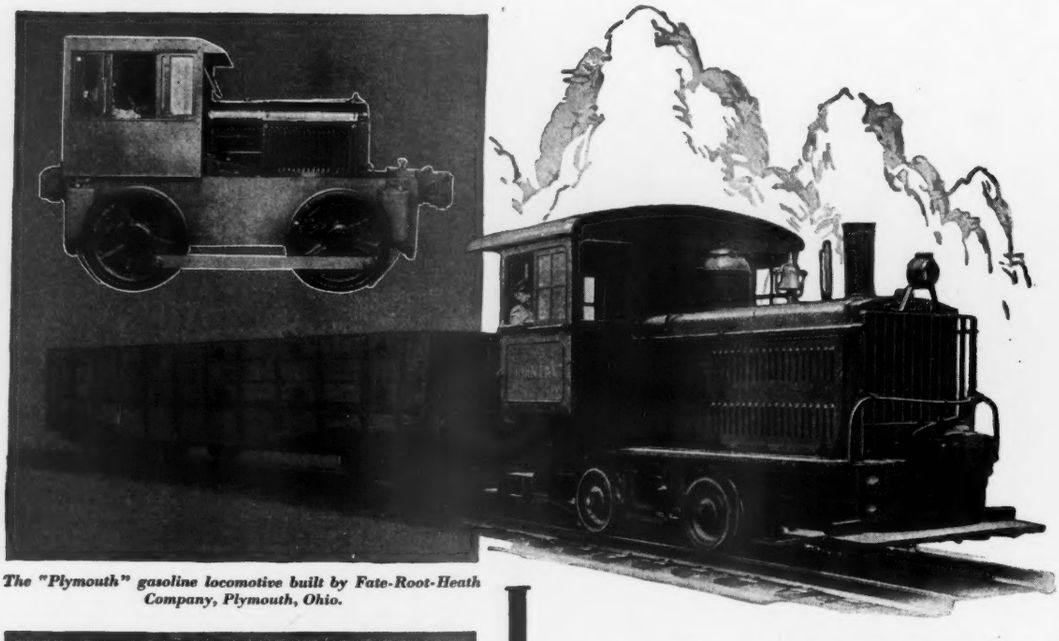
Why not discuss your lubricating problems with a Cities Service engineer? His specialized training puts him in a position to give you valuable help.

CITIES SERVICE OIL COMPANY
60 Wall Street, New York

Cities Service Radio Concerts, Fridays, 8 P.M., Eastern Standard Time—WEAF and 33 Stations on N.B.C. Coast-to-Coast network.

INDUSTRIAL OILS
BE PROVED IN INDUSTRIAL USE

Gasoline industrial locomotive built by Atlas Machinery & Supply Company, Birmingham, Ala.



The "Plymouth" gasoline locomotive built by Fate-Root-Heath Company, Plymouth, Ohio.

LOAD-ABILITY!

that's what counts ~ ~ ~

in BEARINGS as well as LOCOMOTIVES

THE two manufacturers whose products are here pictured, design and build their locomotives with the idea of maximum haulage capacity at minimum cost for fuel and upkeep. They must handle their loads with economy and dispatch.

NORMA-HOFFMANN Precision Bearings are used by both these locomotive builders—because they have the load-ability which haulage service demands and which contributes so largely to uninterrupted operation at least cost for bearing upkeep.

Wherever loads are heaviest, or speeds highest, or duty hardest, there is the place where PRECISION, as a commercially valuable quality, reveals its true worth.

Let our engineers work with you, on your bearing problems. And ask for the Catalogs.

"NORMA-HOFFMANN"

PRECISION BEARINGS

NORMA-HOFFMANN BEARINGS CORPORATION STAMFORD, CONN., U.S.A.

In a plant like General Electric at Bridgeport, maintenance is a problem . . .

In any plant, for that matter, lowest cost of maintenance is a big objective.

General Electric, at Bridgeport, Conn., faces this problem squarely. How the company takes measures to keep belting maintenance at the minimum on certain unusual drives speaks well for Fabreeka Belting.

Approximately 1,200 feet of Fabreeka Belting are in use, 1¼ in. wide and used on a right angle bend drive for cotton winding machines, running over approximately 9 small pulleys. Fabreeka drives last approximately 3 months, running day and night—9 hours each.

Four years ago Fabreeka was selected for this work, and today the company reports—"*As far as performance and service rendered by Fabreeka Belting, we found this type of belt the most suitable for this class of work and working very satisfactorily.*"

Remember, belting that ages or oxidizes, has selvages or folds to fray or open up, and stitching to break, is apt to impose a heavy burden on maintenance costs. Unlike leather or rubber, Fabreeka has none of these disadvantages. It simplifies your maintenance problem as far as belting is concerned by assuring longer life. Any test on any drive will prove this.

May we forward, without obligation, the Fabreeka Data Sheet and a sample of the belt?

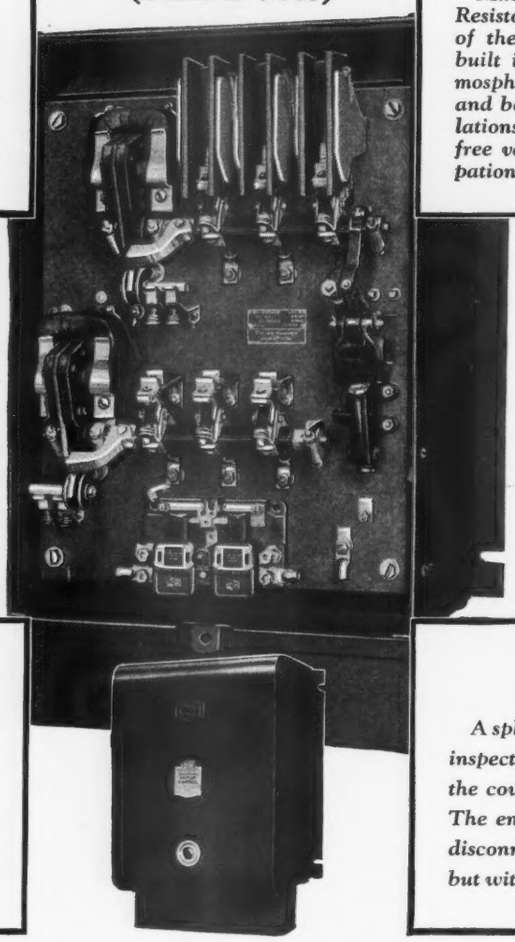
FABREEKA BELTING COMPANY
20 East Street, Boston, Mass.
New York: 461 Eighth Ave., Chicago: 529 So. Franklin St.

FABREEKA BELTING

Consistently Accurate Overload Relay

Exceptional accuracy of famous C-H Overload Relay, maintained without variation during its long life, assures the utmost in production from equipment, at the same time affording thorough protection to motor against overheating. If the load can be moved, C-H Primary Resistor Starter will force the motor to accelerate it.

(Bulletin 9605)



Long-Life Resistors

Much of the service of a Primary Resistor Starter depends upon the life of the resistors. C-H Resistors are built immune to moisture-laden atmosphere. And they are screened top and bottom to prevent dust accumulations, at the same time permitting free ventilation and full heat dissipation.

Ease of Wiring

The wiring channel which is below the starter proper, assures easy accessibility for wiring. Panel is removable from case also without disturbing the conduit. Men can work in full freedom and safety.

Ease of Repair

A split case is provided to facilitate inspection and adjustment. Opening the cover makes all parts accessible. The entire panel is removable upon disconnecting terminal connections but without disturbing the conduit.

Meeting your four-fold need in Primary Resistor Starters

Cutler-Hammer Primary Resistor Starter (Bulletin 9605) embodies to the fullest extent the well-known Cutler-Hammer standards of durability, efficiency and trouble-free service . . . the well-known standard of "Millions of Operations". The way this starter meets every essential need is indicated above. Other features that warrant your selection of C-H Primary Resistor Starters are: the Thermal Overload Relay is reset, made ready for the next dangerous overload simply by pushing a button; the design of the solenoid magnet and contactors assures cool operation and freedom from pitting; rugged bearings give extra years of service; chimney-type arc shields and heavy blow-out coils reduce arcing to a minimum.

Full information as to this long-life Starter will be sent upon request.

CUTLER-HAMMER, Inc.
Pioneer Manufacturers of Electric Control Apparatus
1205 St. Paul Avenue
MILWAUKEE : WISCONSIN

CUTLER HAMMER

The Control Equipment Good Electric Motors Deserve

(A-218)

Supermal • • • • •

A Superior Metal for Chains and Buckets

Embodying Greater Resistance To Wear, Higher Tensile Strength and Higher Elastic Limits than Heretofore Attained in Malleable Iron

In the field of chain manufacture, Jeffrey has for a half century continued to anticipate industry's requirements. The processing of malleable iron to give it the combined characteristics of extreme hardness and of strength without sacrificing toughness has been a practice with the Jeffrey Company for more than twenty years.

Modern elevating and conveying requirements for metals embodying higher resistance to wear and greater strength have caused our engineers to apply the Jeffrey process for making a greater wear-resisting malleable more generally.

After 5 years of thorough laboratory and field tests, Jeffrey now offers all industries its greatest development in malleable chains and buckets under the registered trade name of "Supermal".

Jeffrey Supermal Chains and Buckets operating under the most severely abrasive conditions have established performance records that surpassed the greatest expectations of Jeffrey Research Engineers.

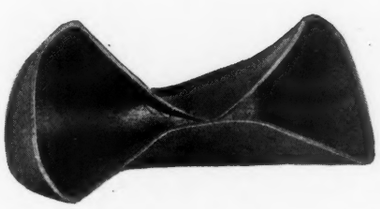
Important Qualities

Supermal is all that the name implies. It is a metal different from anything now on the market, with a greatly increased resistance to wear over that of malleable iron. It is "FILE HARD" — it cannot be touched on the surface with the flat of a file, yet it retains those desirable qualities of malleable iron — toughness and ductility.

Although, of lesser practical importance, it is interesting to note that Supermal also has a much higher tensile strength and a higher elastic limit than that of average malleable iron.

The qualities of wear resistance, high tensile strength and high elastic limit found in Jeffrey Supermal Chains compare very favorably with those of manganese steel chains, yet the increase in cost is only little more than ordinary malleable chains and substantially less than that of manganese chains.

Although the greatly increased life of Supermal with only a small increase in price over malleable iron more than justifies its use under abrasive or gritty conditions, there are other savings which add to its worth for handling abrasive materials. Fewer replacements mean a smaller labor charge, and less frequent interruptions of operation due to these replacements.



Unusual Qualities Illustrated

The photographs of Supermal buckets, shown at the left, illustrate the two very unusual properties — great wear resistance and ductility — that are so successfully combined in this superior malleable. The "FILE HARD" surface of these buckets does not produce a brittle material even in thin sections. These buckets can be pounded and distorted far beyond any working requirements before breaking.

Another remarkable fact is that these hard buckets can be drilled and punched—see illustration. The three upper holes have been punched; the two lower holes have been drilled. The lower illustration shows a Supermal elevator bucket after it has been pounded out of shape with a 15 pound sledge. Chains and buckets made of Supermal will withstand severe shock and fatigue loads without breaking.

Physical Characteristics Compared

The table below shows some interesting comparisons of Jeffrey Supermal with average malleable iron, soft cast steel annealed and manganese steel.

Name of Material	Yield Point Pounds Per Sq. Inch	Ultimate Strength Pounds Per Sq. Inch	Elongation Per Cent in 2"	Brinell Hardness Number	Scleroscope Hardness
Malleable Iron	*30,000	*50,000	*10.0 Min.	121	25-30
Soft Cast Steel Annealed	30,000	60,000	24.0 Min.	140	25-30
12% Manganese Steel	50,000	85,000 Min.	35.0	200	**35
Supermal	51,000	65,000	8.0	180.200	40.45

* Minimum Standard set by American Society for Testing Materials.
** Heat treated but not cold worked. Cold working increases Scleroscope hardness on the surface to about 70.

Important Uses

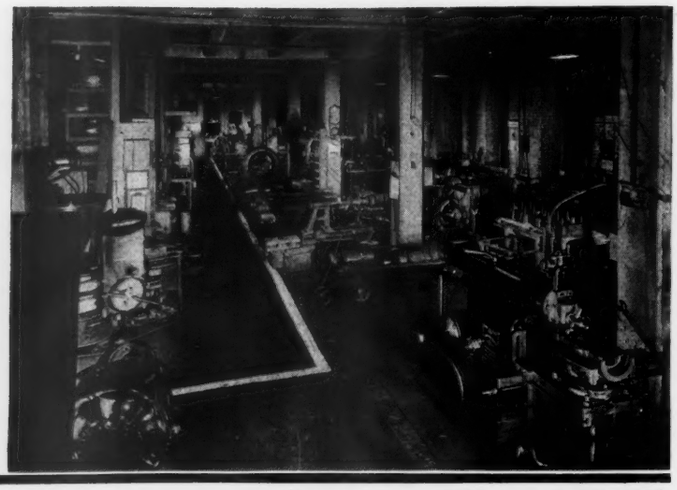
Jeffrey Supermal is recommended for conveyors, elevators and chain drives subject to abrasive or gritty condition.

It is also recommended for chain drives where something harder and stronger than standard malleable iron is required to withstand severe usage.

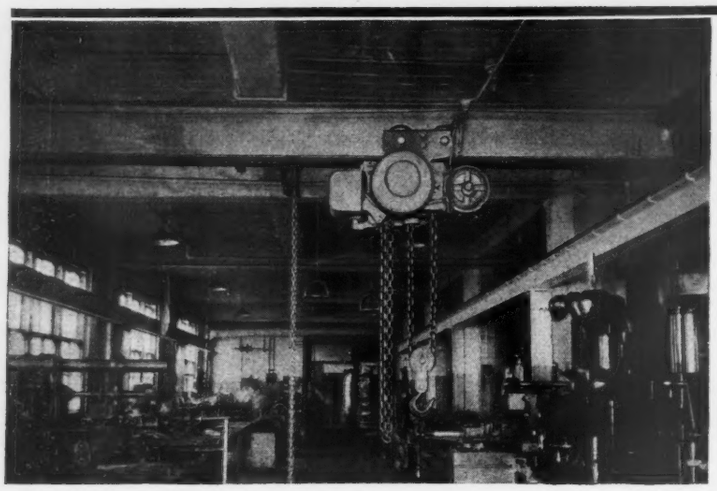
Supermal chains, attachments and buckets can be furnished in all standard sizes. The most popular types and sizes of Jeffrey Supermal Chains and Buckets are listed in Bulletin No. 501, which will be sent to those interested in greater wear resistance combined with toughness and unusual strength in malleable chains ar ' buckets.

THE JEFFREY MANUFACTURING COMPANY
951-99 North Fourth St., Columbus, Ohio
The Jeffrey Mfg. Co., Ltd. of Canada **Main Office: Montreal**

GENERAL ELECTRIC SERVICE SHOPS IN



KANSAS CITY AND ST. LOUIS



TWO LINKS IN A NATION-WIDE CHAIN of G-E SERVICE

(Above) A section of the Kansas City Service Shop

(Upper right) A section of the St. Louis Service Shop

A talking motion picture describing the facilities available in General Electric Service Shops has recently been completed. If you would like to see it, your nearest G-E office or Service Shop will arrange a showing. G-E Service Shops are located in the following cities:

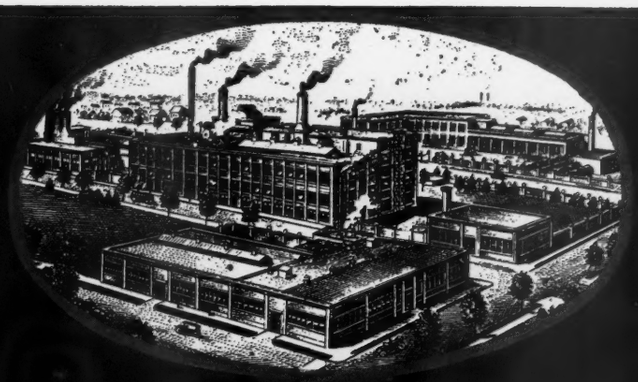
Atlanta
Buffalo
Chicago
Cincinnati
Cleveland
Dallas
Detroit
Erie
Fort Wayne
Houston
Kansas City
Los Angeles
Lynn
Milwaukee
Minneapolis
New York
Philadelphia
Pittsburgh
Pittsfield
St. Louis
Salt Lake City
San Francisco
Schenectady
Seattle

SERVING a large industrial area in the central portion of the United States, the Kansas City and St. Louis Service Shops of the General Electric Company are important links in a nation-wide chain of G-E service. Like G-E Service Shops in twenty-two other cities, they are equipped with adequate machinery, both mechanical and electric, to restore all types of electric equipment to original factory standards. Call at the G-E Service Shop nearest you and become acquainted with its facilities—ready to serve you with speedy and accurate electrical repairs.

91-47

JOIN US IN THE GENERAL ELECTRIC PROGRAM, BROADCAST EVERY SATURDAY EVENING ON A NATION-WIDE N.B.C. NETWORK

GENERAL ELECTRIC SERVICE SHOPS



IRVINGTON INSULATION

Offering A Complete Line of

Bias Varnished Cambric Tapes

IRVINGTON
Super Seamless
Bias Tape

Highest grade, closely woven cloth—with electrical qualities at the highest point.

IRVINGTON
Standard Seamless
Bias Tape

Slightly lower count cloth and lower electrical qualities than Super Seamless . . . at lower cost.

IRV-O-Flatseme

The Most Economical Bias Tape

A sewed seam—double stitched and completely insulated every 34 inches—seams only .005-.007 thicker than body of tape. Electrical qualities at highest point.

Costs less than any seamless bias tape.

Super Seamless Irv-o-Flatseme Standard Seamless

Irvington Varnish & Insulator Company

Irvington, New Jersey

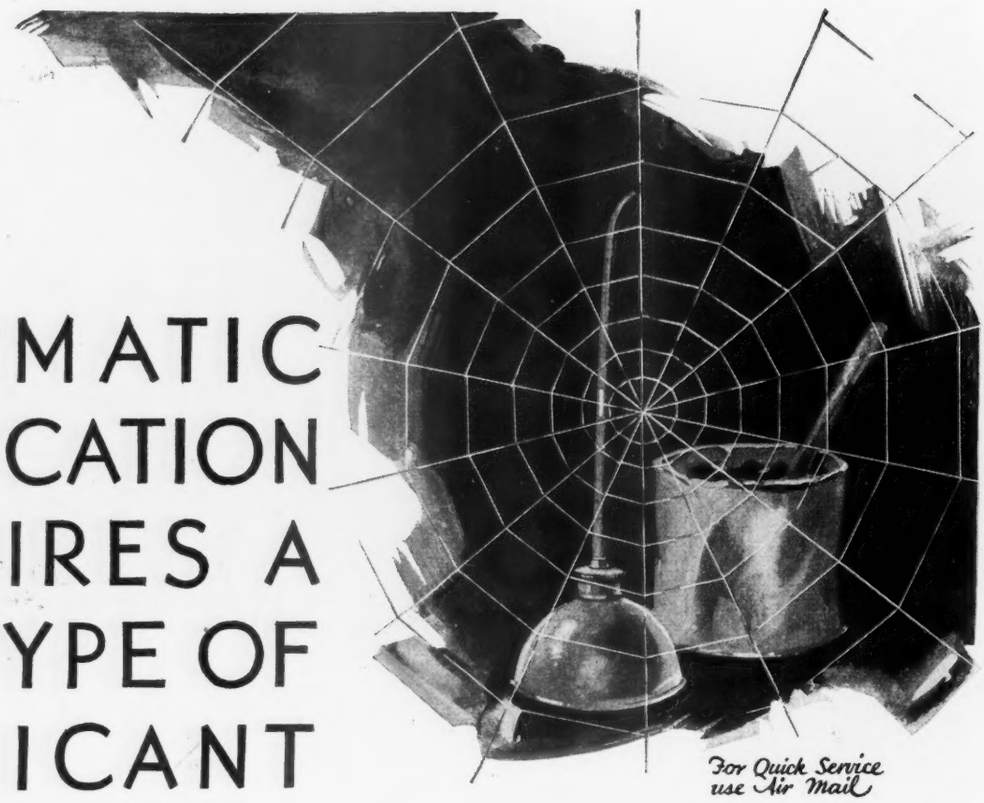
Established 1905

Mitchell-Rand Mfg. Co., New York
White Supply Co., St. Louis
E. M. Wolcott, Rochester
Martin Woodard, Seattle

Sales Representatives

Earl B. Beach, Pittsburgh, Pa.
Electric Insulation Co., Philadelphia, Pa.

Prehler Bros., Inc., Chicago
Prehler Bros., Inc., Cleveland
Clapp & La Moree, Los Angeles
A. L. Gillies, Toronto



AUTOMATIC LUBRICATION REQUIRES A *New* TYPE OF LUBRICANT

MODERN machinery design and modern methods of maintenance are calling more and more for mechanical lubricating equipment. Centralized devices, high pressure systems and sight feed oilers are replacing the old oil can and grease cups.

But modern lubricating equipment is only half the story. After all, this equipment is but a means to get lubrication to the point of wear. The lubricant also must be modern—must have the characteristics to meet the peculiarities of the lubricating devices. Are you sure that your lubricants match your lubricating equipment?

S. O. C. I. Lubricants are modern. They have been developed for use in modern lubricating equipment. Your lubricating equipment will operate as the manufacturers intend it to, if you use the proper S. O. C. I. lubricants.

Call in one of our lubrication engineers. It will cost you nothing nor entail any obligation. His recommendations, if followed, will assure you of getting lubrication that is modernized completely.

STANDARD OIL COMPANY, (*Indiana*)
General Offices: 910 South Michigan Ave. Chicago, Illinois

STANDARD OIL COMPANY (INDIANA) SERVICE

Chicago	Detroit	Grand Rapids	Joliet	Mason City	Saginaw	South Bend
Davenport	Duluth	Green Bay	Kansas City	Milwaukee	Sioux City	St. Louis
Decatur	Evansville	Huron	La Crosse	Minneapolis	Peoria	St. Joseph
Des Moines	Fargo	Indianapolis	Mankato	Minot	Quincy	Wichita

LUBRICANTS FOR ALL INDUSTRY

SPRU-CO-LITE

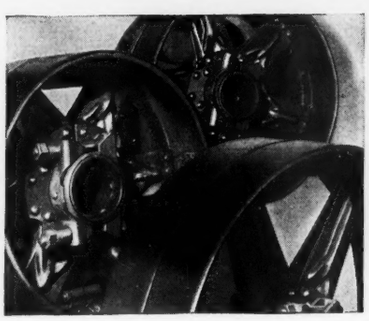
TRACTION
to turn power into
PROFITS

Motors talk through PULLEYS.

When pulleys slip, motor efficiency slumps. Manufacturing costs mount. Lost power becomes friction heat, which may wear, burn or destroy a belt.

Clinging, driving, fibres of Spruce wood, compressed into a homogeneous substance uniform in texture, hard and marvelously wear resisting. This is *Sprucolite*, the last word in motor and machine pulleys. Sprucolite possesses the highest coefficient of friction for belt transmission of power. With an uncanny ability it holds the belt and sends it on its way with a minimum power loss. This special synthetic material developed particularly for belt pulley use is also light in weight. For service ordinary or extraordinary, Sprucolite Pulleys are recommended.

Sprucolite Pulleys are now available as optional equipment for the business ends of all leading makes of motors. Specify them when ordering. For plant operators who wish to replace the ordinary pulleys on equipment already in use, AMERICAN Sprucolite Pulleys are carried by a large number of mill supply dealers from coast to coast. Ask your dealer about Sprucolite or write for further information.



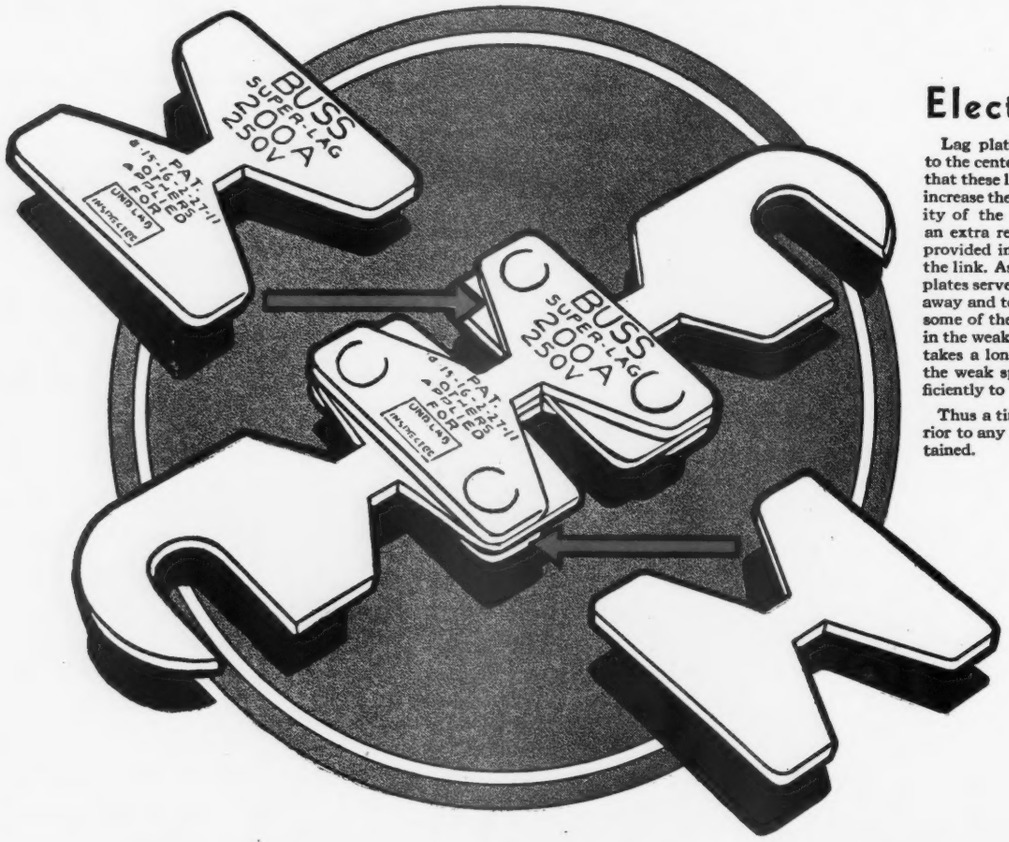
Over 7 million AMERICAN Pressed Steel Shafting Pulleys and Hangers have been put to work in leading plants throughout the country. Light, strong, durable power transmission units, they are regarded as the standard of quality wherever shafting pulleys and hangers are used.

AMERICAN
SPRUCOLITE
PULLEYS

THE AMERICAN PULLEY CO.
4200 Wissahickon Ave. Philadelphia, Pa.

Pressed Steel: **Shafting Pulleys, Hangers, Hand Trucks, Miscellaneous Stampings.** ***Sprucolite*** **(Compressed Spruce) Motor Pulleys, Machine Pulleys.**

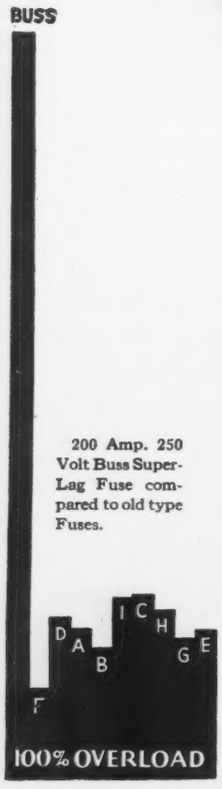
WHY IT WORKS



Electrically

Lag plates are attached to the center of the link. So that these lag plates do not increase the carrying capacity of the link too much, an extra reduced section is provided in the center of the link. As a result the lag plates serve only to conduct away and temporarily store some of the heat generated in the weak spots, so that it takes a longer time to get the weak spots heated sufficiently to blow.

Thus a time-lag far superior to any other fuse is obtained.



200 Amp. 250 Volt Buss Super-Lag Fuse compared to old type Fuses.

To Save the User Money

IN the every day operation of an electrical circuit there are bound to occur many temporary overloads which in themselves would not be harmful to wiring or equipment and would not cause an interruption of service.

When fuses blow needlessly on such harmless overloads, because of a short time-lag, they cause unnecessary and costly shut-downs.

By increasing the time-lag—the time required to blow the fuse—BUSS SUPER-LAG Fuses safely carry many of these temporary or harmless overloads without blowing. Yet the design is such that they give positive protection against dangerous overloads and short-circuit conditions superior to that of any other fuse.

By reducing the number of needless blows BUSS SUPER-LAG Fuses increase operating efficiency. No longer need machines stop, workmen stand idle and production cease because a fuse blew due to short time-lag.

GLANCE AT THE CHART

An indication of what BUSS SUPER-LAG Fuses mean to the user because of their superior time-lag can be seen from the chart on the left which shows how they compare with others. This chart is based upon tests made by the Electrical Testing Laboratories of New York and reported by them on August 25th, 1930. It shows how a 200 ampere 250 volt BUSS SUPER-LAG Fuse compares with other fuses at 100% overload.

30, 60, 100, 400 and 600 ampere sizes show similar results.

YOU BE THE JUDGE

The only true way to judge what the SUPER time-lag of BUSS Fuses will mean to the user is to put the fuses on trial in actual service.

The user who does this will find out-of-service losses decreased and a material reduction in the cost of his fuse protection.

If you would like more complete information about BUSS SUPER-LAG Fuses before trying them in service we will be glad to have a BUSS Representative call on you or send complete data by mail.

Let us know your preference.

BUSSMANN MANUFACTURING COMPANY, 2536 W. University St., St. Louis, Mo.
A Division of the McGraw Electric Company

THE **BUSS SUPER-LAG** FUSE

The Choice of Experts!

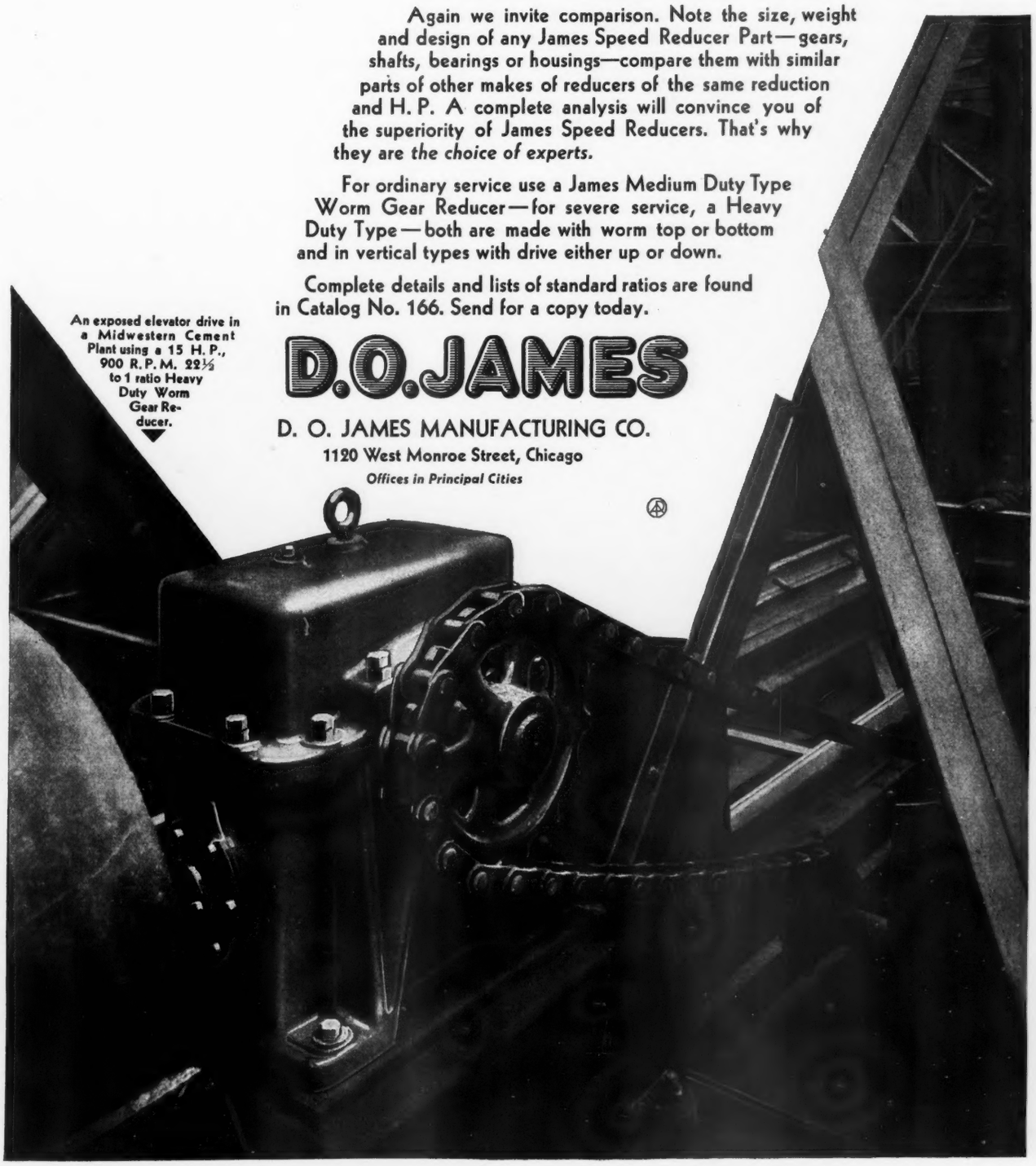
If the job requires a worm gear speed reducer—get the best—get a James. Leading engineering concerns in every division of Industry *specify James.* They're truly *the choice of experts.*

The reasons for this preference are—James design, construction, service and the James guarantee which provides absolute precision of worms and worm gears.

Again we invite comparison. Note the size, weight and design of any James Speed Reducer Part—gears, shafts, bearings or housings—compare them with similar parts of other makes of reducers of the same reduction and H. P. A complete analysis will convince you of the superiority of James Speed Reducers. That's why they are *the choice of experts.*

For ordinary service use a James Medium Duty Type Worm Gear Reducer—for severe service, a Heavy Duty Type—both are made with worm top or bottom and in vertical types with drive either up or down.

Complete details and lists of standard ratios are found in Catalog No. 166. Send for a copy today.



An exposed elevator drive in a Midwestern Cement Plant using a 15 H. P., 900 R. P. M. 22½ to 1 ratio Heavy Duty Worm Gear Reducer.

D.O.JAMES

D. O. JAMES MANUFACTURING CO.

1120 West Monroe Street, Chicago

Offices in Principal Cities

TALK NUMBER TWELVE BY A PROMINENT DISTRIBUTOR

"Judge for Yourself Don't You See That . .

Above—Mr. L. H. Irwin, President, and Mr. J. N. Succop, Treasurer, of The Republic Rubber Company of Pittsburgh, Pittsburgh, Pa. This company's services are of a definite economic value to the prosperity of its business territory.

THERE is no more direct route for merchandise to flow in than through houses of our kind. Regardless of the name or type of distributor they must absorb our functions and our costs of selling. Our strength and value is predicated on the common sense way in which this point is viewed."

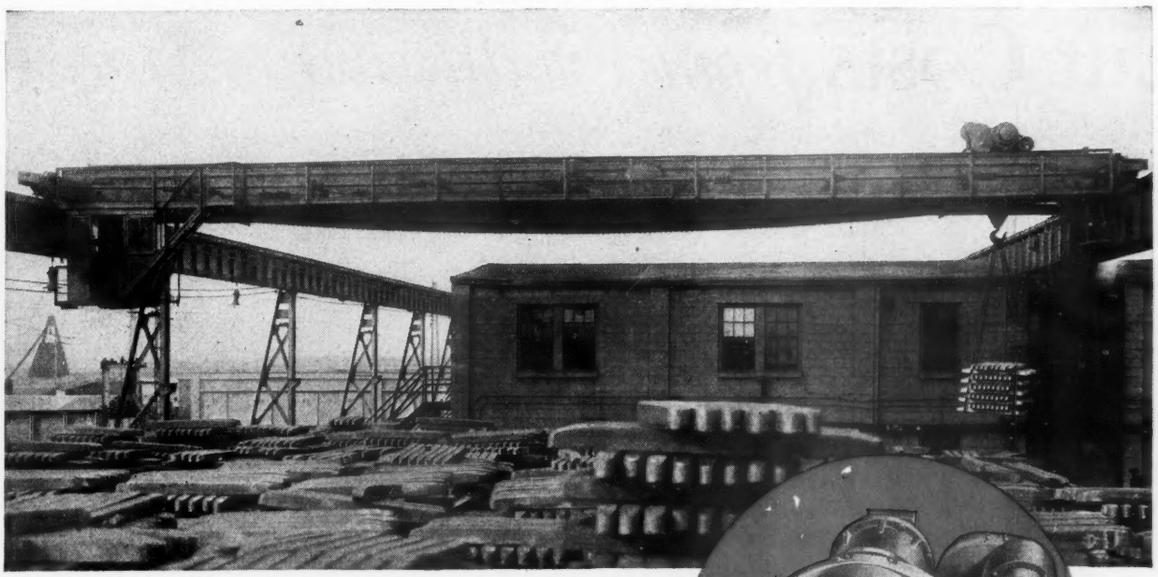
The above statement is characteristic of those made by prominent distributors all over the country. It explains in part how the Industrial Supply Distributor, helping to solve the important problem of broad markets and economical distribution, upholds high quality, maintains fair prices and saves needless efforts on the part of both consumer and manufacturer.

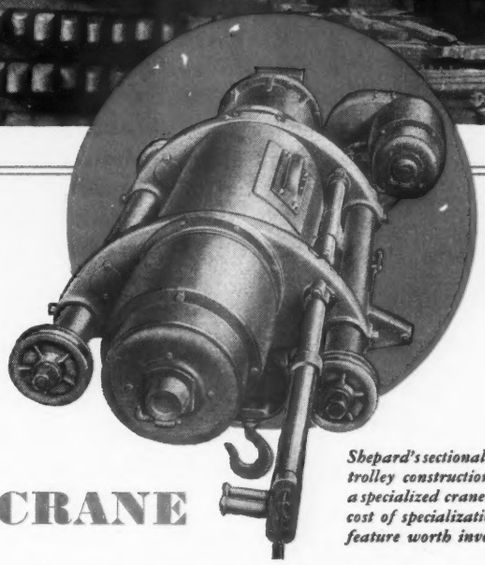
Invader Belting is as old as is Republic (28 years.) Invader will work satisfactorily anywhere, except on abnormal drives calling for super quality such as is in Champion High Speed.

Send for a sample of INVADER

THE
REPUBLIC RUBBER CO.
Youngstown
Ohio

REPUBLIC means the Best Mechanical Rubber Goods





LIFT...
to higher profits
WITH A SHEPARD CRANE

Shepard's sectionalized crane trolley construction provides a specialized crane minus the cost of specialization. It's a feature worth investigation.

COPPER pigs, is the load that this weather-beaten veteran is handling at the Raritan Copper Works, Perth Amboy, N. J. Its been at it for more than 13 years, 10 to 12 hours daily, rain or shine, in true Shepard fashion . . . trouble-free, low maintenance, dependable.

Shepard's construction is dust-, dirt- and moisture-proof . . . the enclosed units defy the elements completely. The Balanced hoisting mechanism, permanently aligned and automatically lubricated, absorbs the stress and strain of hard service. Small wonder the years rest so lightly on Shepards!

Indoors or out, Planned Overhead Load-Handling can do a lot to lift your profits. Take full advantage of the specialized knowledge of Shepard Engineers in applying the electric crane or hoist precisely suited to the job. Send your inquiries to Montour Falls.

SHEPARD NILES CRANE & HOIST CORPORATION

Main Office: 415 Schuyler Ave., Montour Falls, N.Y.

Works: Montour Falls, N. Y., Phila., Pa. Branches in Principal Cities

Member EMA Electric Hoist Manufacturers Association

SHEPARD CRANE & HOIST DIVISION

THE MOST COMPLETE LINE OF CRANES & HOISTS IN AMERICA

Cut Costs *from Production to Storage* with Industrial Trucks

Fast-moving electric trucks and tractors save money in material-handling . . . reduce storage costs

FIGURE storage space on the basis of productive value. Keep inventories low. Save actual dollars. Many companies are reducing material-handling costs with fast, efficient electric industrial trucks. Stock is moved in and out quickly. Congestion is avoided. And each truck frees from one to ten men for more productive work.

Here's How One Firm Saves Money

A well-known paper manufacturer in New Jersey has used electric industrial trucks, equipped with Exide-Ironclad Batteries, for several years. Formerly sixteen men were required to handle materials. Now only six are necessary to keep the load off the floor . . . ten men released for more profitable work! The estimated savings in labor, storage, and production amount to approximately $8,400.00 per year.

You too can save money and valuable time with Exide-Ironclad-equipped electric industrial trucks. Skilled engineers have specially designed the Exide-Ironclad to furnish steady, even power under the toughest conditions of industrial truck service. Exide-Ironclads are economical at the charging panel, taking current quickly and with little waste. They maintain a consistently high voltage that gives power to make the hardest haul seem easy. And backed by 42 years' experience in building batteries for every purpose Exide-Ironclads are designed to give years of trouble-free performance.

Write for Complete Details

A letter brings your copy of Bulletin 160-R. It tells you about the many uses of dependable, efficient Exide-Ironclad Batteries in different industrial truck services. And shows how savings may be effected. Write today.

Industrial Trucks powered with Exides move stock quickly . . . keep the load off the floor—cut inventory expense.

Exide
IRONCLAD
BATTERIES

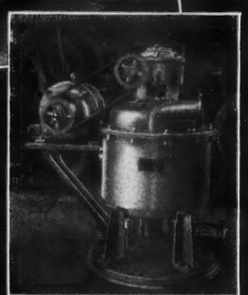
THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia
Exide Batteries of Canada, Limited, Toronto

THE WORLD'S LARGEST MANUFACTURERS OF STORAGE BATTERIES FOR EVERY PURPOSE

Your Drive too-

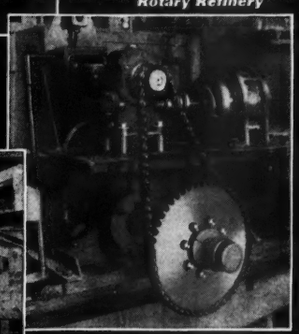
Can Be Made More Efficient, Safe, Dependable and Economical in Operation with an IXL Speed Reduction Unit

3 HGS "Hygrade" Worm Gear Reducers Driving MacIntosh Mills

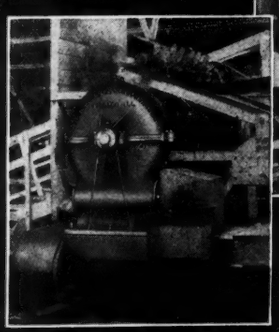


"Hygrade" Vertical Worm Gear Reducer Operating Arpin Rotary Refinery

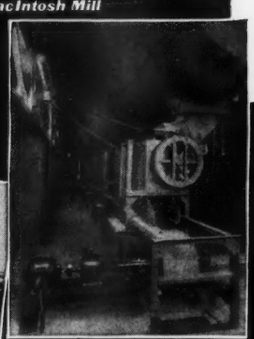
Type W Worm Gear Reducer Driving Sacking Conveyor in Phosphate Plant



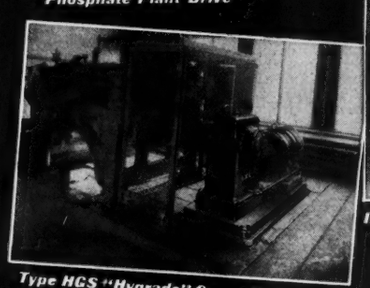
Type HGS Worm Gear Speed Reducer Operating MacIntosh Mill



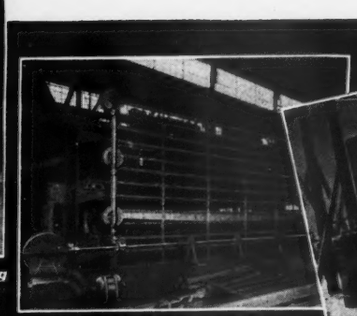
40W Worm Gear Speed Reducer Operating 400 Ton Phosphate Plant Drive



IXL Spur Gear Reducer Driving Conveyor Belt in Large Chemical Plant



Type HGS "Hygrade" Speed Reducer Driving A Paint Mill



Type W Reducer Driving Large Rubber Drying Conveyor

IXL Herringbone Speed Reducer Driving Conveyor in Large Clay Plant

THESE illustrations show a few of the hundreds of special problems which have been solved by the use of these compact, enclosed efficient drives.

IXL Speed Reducers are built in all types and sizes to meet all requirements. Let our engineering department recommend the ones best suited to your purpose.

Established 1859

IXL Products:

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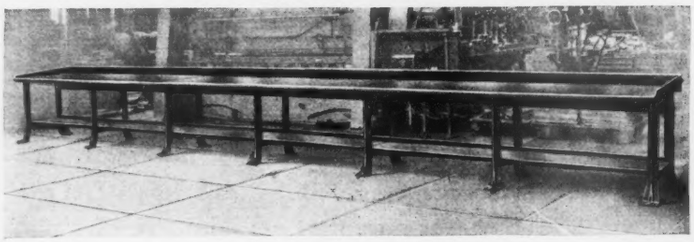
Or A Little of Everything



Pat'd and Pat's Pend'g

Fig. 722—"HALLOWELL" Continuous Work-Bench of Steel. Strong, rigid, fireproof, lasts a lifetime, made any length, shipped from stock. Steel Top is smooth, won't splinter, crack and absorb oil. Complete Bench data in Bulletin 386.

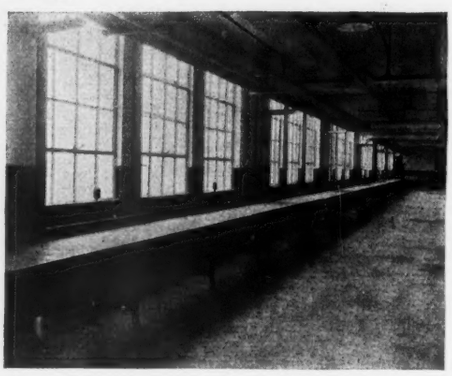


Fig. 969—Look at the length and perfectly smooth top of this **"HALLOWELL" Work-Bench of Steel**—so easy to keep clean while the open construction below admits of no dirt traps.

Pat'd and Pat's Pend'g

Pat'd and Pat's Pend'g

Pat'd and Pat's Pend'g

Fig. 732—These "HALLOWELL" Work-Benches of Steel were built from the standardized parts of the bench in Fig. 722, after it had been dismantled. Wooden benches could not be rebuilt like that because, once torn apart they are only fit for kindling. Complete bench data in Bulletin 386.

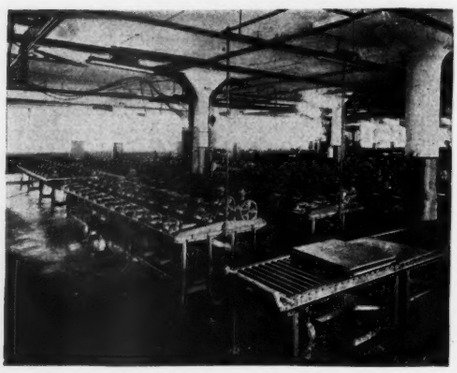


Fig. 971—This shows merely a corner of a large installation of **"HALLOWELL" Work-Benches of Steel**—there were six floors in all. Some layout, you will admit, and speaks well for the **"HALLOWELL."**

Fig. 970—An interior of the Wrapping Department in a large publishing house with an imposing battery of extra wide **"HALLOWELL" Wrapping-Tables of Steel.** Look a little closer and the reflections in the steel tops are plainly noticeable — that's how smooth, shiny and serviceable these **"HALLOWELL" Steel Tops** are.

Pat'd and Pat's Pend'g

Fig. 709—"HALLOWELL" Worktable of Steel—General construction same as that of the Work-Benches shown above, only the top is get-at-able from all sides—no end pieces, no back board. Complete data in Bulletin 386.

Fig. 923—"HALLOWELL" Work-Bench of Steel with Laminated Plank in front. In certain industries wooden tops are preferred, particularly where edge tools are used and fine work is being done. Laminations prevent warping, cracking and splintering. Get Form 420.

Pat'd and Pat's Pend'g

STANDARD PRESSED STEEL CO.

BRANCHES
BOSTON
CHICAGO
DETROIT

JENKINTOWN, PENNA.

BOX 546

BRANCHES
NEW YORK
SAN FRANCISCO
ST. LOUIS

? Will your speed reducers escape the Red Question Mark next year?

1930 has been a test-year for production costs.

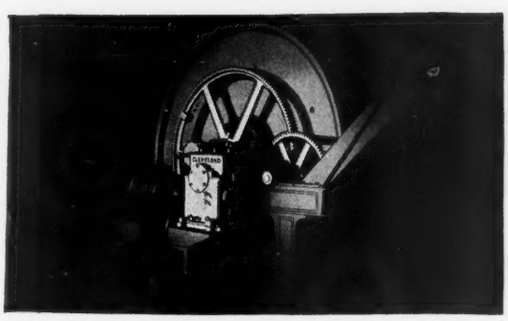
With maintenance and operating figures carefully sifted . . . broken up into smaller lumps . . . cost items have been reviewed by super-critical eyes.

Red question marks have appeared more frequently on the cost sheets.

Exacting analysis has proved again that a single breakdown . . . men and machines standing idle for a few hours . . . production tie-ups . . . repairs quickly overbalance any saving in purchase price that can be made by specifying a less-than-first quality speed reduction unit.

More forcibly than ever, it has been demonstrated that the HIGHEST QUALITY SPEED REDUCER IS THE MOST ECONOMICAL.

Resolve now to "play safe" next year. Protect yourself by insisting on WORM GEAR speed reducers that will not fail when the sudden shocks and overloads come . . . speed reducers that require no attention outside of occasional oiling . . . speed reducers you can rely upon . . . "Clevelands".

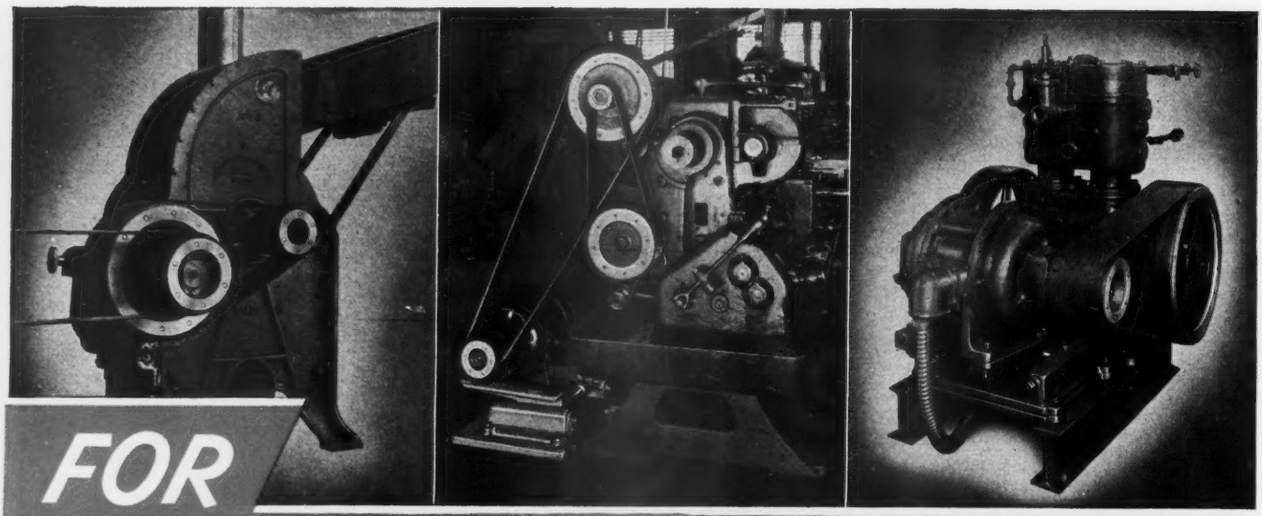


Cleveland Unit Type AT driving dryer. Ratio 8¾ : 1, . . . 5 h. p., 1200 r. p. m.

CLEVELAND
WORM & GEAR COMPANY

3268 EAST 80TH STREET . . . CLEVELAND, OHIO

CLEVELAND WORM GEARING—THE ULTIMATE DRIVE



FOR ECONOMICAL POWER DRIVES — USE

ROCKWOOD

PULLEYS THAT PULL

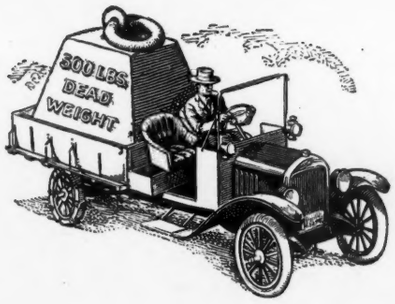
THERE'S NO NEED for "extravagance" in providing drives for your machines! Reliable tests have repeatedly shown that the flat belt drive (*when correctly designed and equipped*) has no equal in efficiency, dependability and economy! . . . It is lowest in first cost—easiest to install and maintain—absorbs shocks and prolongs the life of both driving and driven units, and is *highly efficient*—far more so than any gear, chain or V-belt drive.

For greatest economy in flat belt drives, always use ROCKWOOD Pulleys! Their end-grain fibre surface has *twice* the pulling power of metal pulleys! By eliminating belt slip, ROCKWOOD Pulleys assure longer belt life! Test out their superiority on your hardest drives.

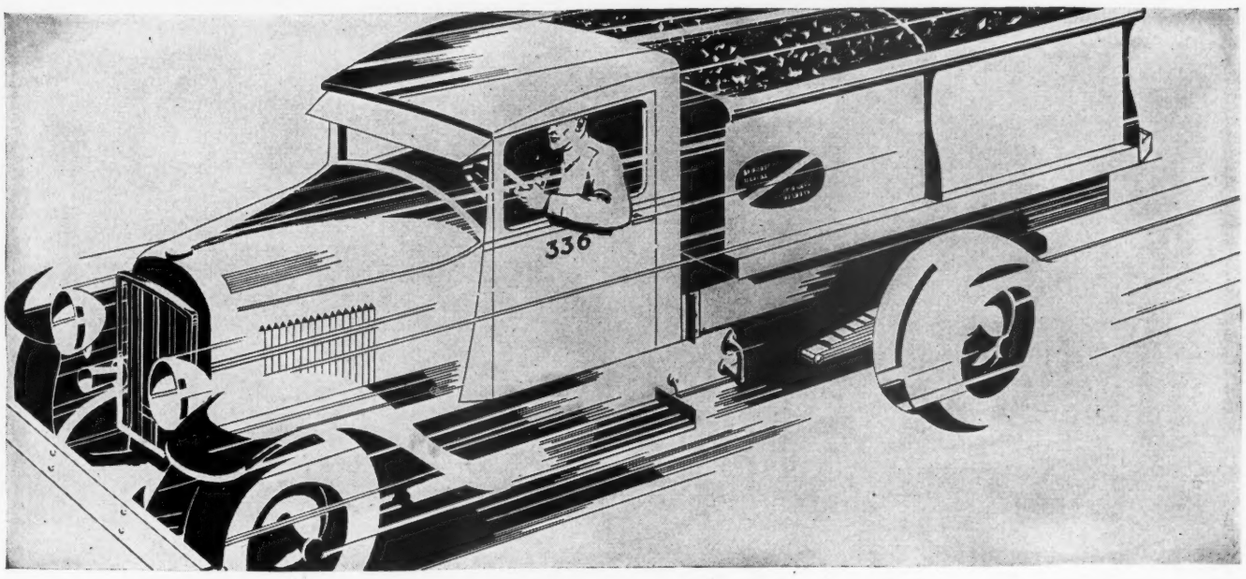
THE ROCKWOOD MFG. COMPANY, *Indianapolis, Ind.*
THE OHIO VALLEY PULLEY WORKS, *Maysville, Ky.*
Divisions of General Fibre Products, Inc.

THE BEST PULLEYS TO BUY...
...THE CHEAPEST PULLEYS TO USE

OVER 2,000 STOCK SIZES—IN ALL PRINCIPAL CITIES



Light on the Dead-load Heavy on the Pay-load



All who do heavy hauling find that to make a profit, loads must be hauled that pay as they go. Gripped in the pincers between State Highway weight limits and small profit margins, structural dead weight is the crux of the problem. Cutting this dead weight in half, Alloys of Alcoa Aluminum furnish the solution.

Exceedingly strong, weighing only ⅓ as much as iron or steel, Alcoa Aluminum for truck body structures is bringing dead weight reduction and astonishing increases in pay-load. As much as 1,400 pounds extra pay-load can be gained on a standard 6 ton truck. For a slightly increased first cost, large savings, due to the lighter weight and increased pay load, are obtained. There are instances where this additional investment pays well over 100% return per annum.

And not only in trucks, but in trolley cars, on railroads—wherever transportation puts "mass in motion"—Alcoa Aluminum is slashing structural dead-weight; transforming dead-loads into pay-loads.

This weight saving with equal strength is the reason Alcoa Aluminum is fast becoming the basic structural metal used in all transportation. But these same savings apply equally well to portable typewriters, vacuum cleaners, furniture and moving parts in all kinds of machinery—for anything that must be made light and strong.

From the research laboratories and development engineers of Aluminum Company of America, a vast fund of information is constantly being dispersed to all industry. Thousands of manufacturers accord the Aluminum Company their confidence and respect—the greatest reward of a progressive civilization.

ALUMINUM COMPANY *of* AMERICA, 2472 Oliver Building, PITTSBURGH, PA. Offices in 19 Principal American Cities.

ALCOA ALUMINUM

Why are they called "Tool Steel" Gears?

Occasionally someone who does not read carefully the description of "Tool Steel" gears, crane wheels, and other products contained in our literature, gets the impression that they are made from a solid homogeneous high carbon tool steel. We have never tried in any way to convey such an impression. Our products are made from a low carbon steel, either plain or alloy to suit conditions, and the wearing surfaces are then carburized and hardened by our own special process to such depth as may be required by operating conditions.

The name "Tool Steel" was selected as a descriptive or trade name for our product because the outside wearing surface is converted by our carburizing process from a low carbon to a high carbon steel having the hardness and high carbon content of a good tool steel.

This high carbon hardened case or wearing surface, testing from 85 to 95 by the scleroscope, penetrates to approximately the depth or limit of permissible wear and gives the long life of "Tool Steel" gears and other products. The soft, low carbon steel core or center of our material, refined by heat treatment, gives the necessary strength and ductility supporting the hardened surface.

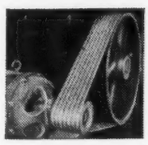
THE TOOL STEEL GEAR & PINION CO.

CINCINNATI, OHIO

O-107

DAYTON COG-BELTS

built to bend



Only in Dayton Cog-Belts can you get the positive and proven features that guarantee long life and maximum operating efficiency in V-Belt Drives.

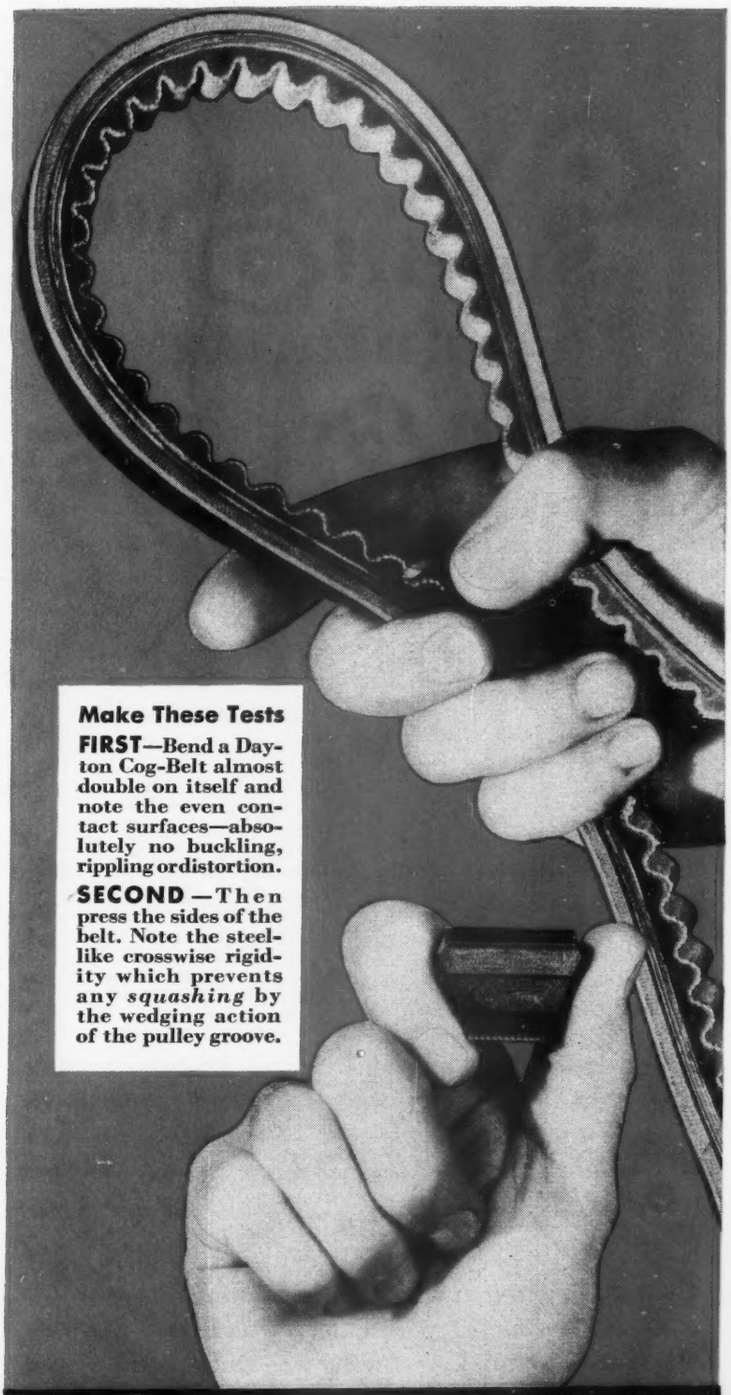
For Dayton Cog-Belts are *built to bend* —without strain or distortion. Their patented construction produces a combination of extreme flexibility and steel-like crosswise rigidity found in no other V-type belt.

Moreover, Daytons are the only V-Belts made with die-cut edges—not moulded —and therefore fit the pulley grooves perfectly and permanently during the life of the belt—they are built by a permanently pre-stretched patented process. That's why Daytons have a firmer grip in the pulley grooves—need less tension—run truer and smoother, require less servicing and last longer.

But get all the facts—complete information about these remarkable V-Belts. Send for the Dayton Cog-Belt catalog and a section of the belt.

THE DAYTON RUBBER MFG. CO.
DAYTON, OHIO

Factory Distributors in Principal Cities and all Westinghouse Electric and Manufacturing Company Sales Offices



Make These Tests

FIRST—Bend a Dayton Cog-Belt almost double on itself and note the even contact surfaces—absolutely no buckling, rippling ordistortion.

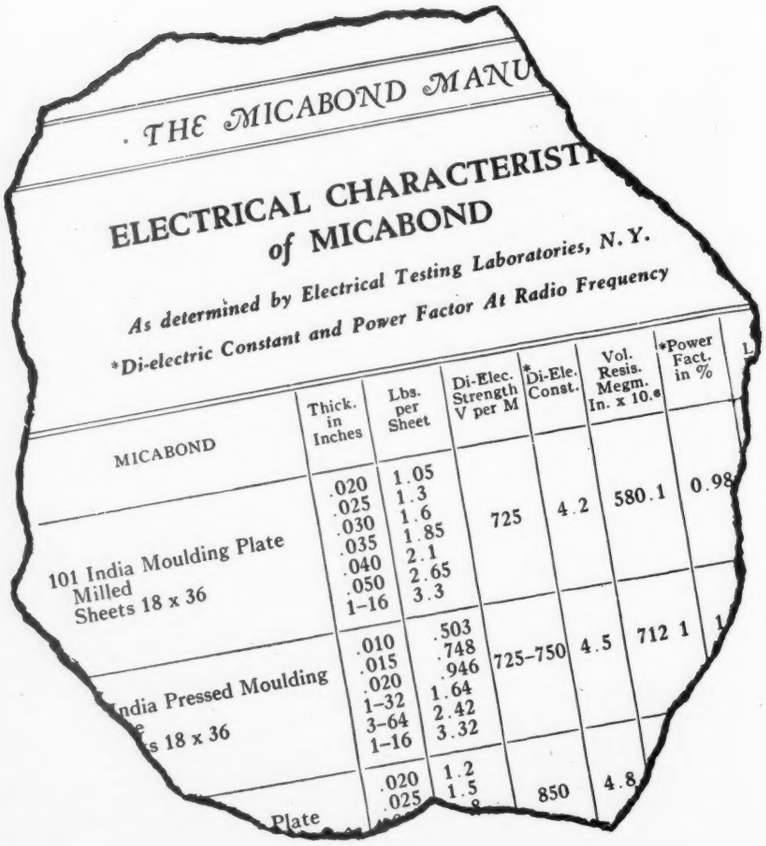
SECOND—Then press the sides of the belt. Note the steel-like crosswise rigidity which prevents any *squashing* by the wedging action of the pulley groove.

Dayton
COG-BELT DRIVES

Complete Drives—Pulleys and Belts—in stock—all ratios 2 H. P. to 100 H. P.

Specific data on the properties of MICABOND

(*MICA IN ITS MOST USABLE FORM*)



THE MICABOND MANU

ELECTRICAL CHARACTERISTI of MICABOND

As determined by Electrical Testing Laboratories, N.Y.

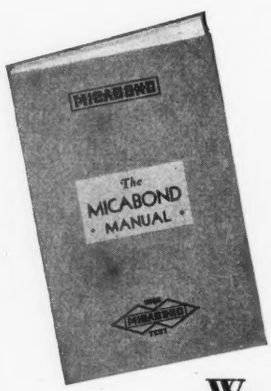
**Di-electric Constant and Power Factor At Radio Frequency*

MICABOND	Thick. in Inches	Lbs. per Sheet	Di-Elec. Strength V per M	*Di-Ele. Const.	Vol. Resis. Megm. In. x 10.⁶	*Power Fact. in %	L
101 India Moulding Plate Milled Sheets 18 x 36	.020 .025 .030 .035 .040 .050 1–16	1.05 1.3 1.6 1.85 2.1 2.65 3.3	725	4.2	580.1	0.98	
India Pressed Moulding s 18 x 36	.010 .015 .020 1–32 3–64 1–16	.503 .748 .946 1.64 2.42 3.32	725–750	4.5	712 1	1	
Plate	.020 .025	1.2 1.5	850	4.8			

Micabond is made in the form of Moulding Plate, Segment Plate, Heater Plate, Flexible Sheet, Strip, Paper and Fish Paper, Cloth, Tape, Tubing and punched parts such as "V" rings, washers, segments and other special shapes.

These various forms of Micabond possess varying characteristics . . . *properties which have been brought out to meet specific insulating needs.* In Micabond Plate, for instance, there are nine distinct types—each made to fit a particular general application.

To help you select the right Micabond product for your insulating needs **we have prepared the new Micabond Manual. It contains information you need, in understandable, usable form . . . a valuable reference book for your files.**



WE'LL be pleased to send you this new Micabond Manual and Catalog . . . with our compliments. Ask for your copy, now.

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WATER

at the touch of a button

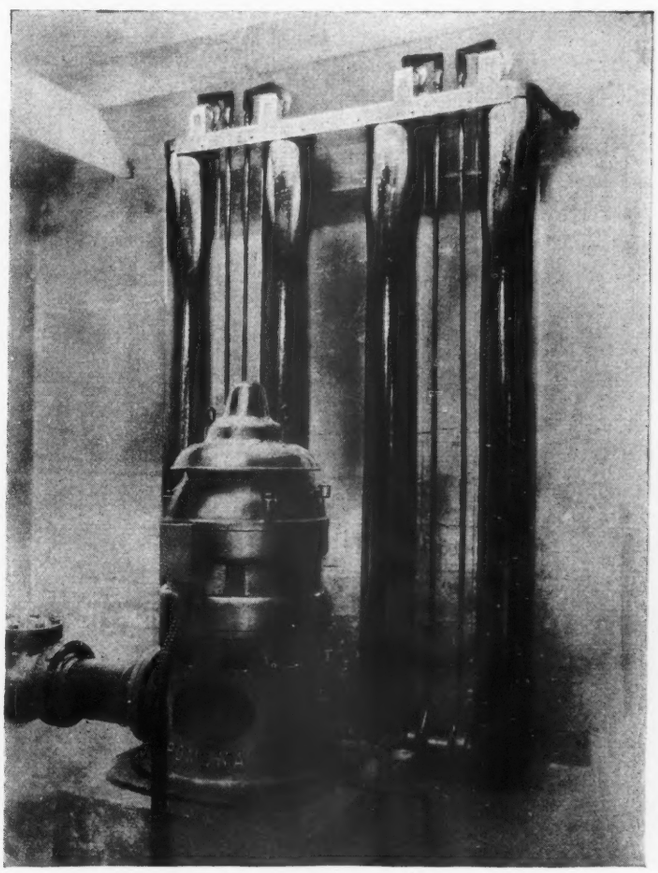
. . . a service made possible by the close cooperation between pump builders and electric motor manufacturers.

Westinghouse is cooperating with pump manufacturers in the application of electric drives to their product, and has worked with them in reaching the common objective of giving you water—at the touch of a button.

In order that Westinghouse equipment shall not be found wanting when called upon to power the pumps, there have been built into Westinghouse motors such fortifying features as: dual-protected windings, combination slot cells, radio frequency tested insulation, and directed air circulation.

And Westinghouse control units—built to match the motors, and the jobs they have to do—offer corresponding features of dependability.

Bear this in mind and the next time you purchase pumping equipment buy good pumps equipped with Westinghouse motors.



Westinghouse Motor driving a Pomona pump in an industrial plant.

Service, prompt and efficient, by a coast-to-coast chain of well-equipped shops

Westinghouse

WESTINGHOUSE ELECTRIC

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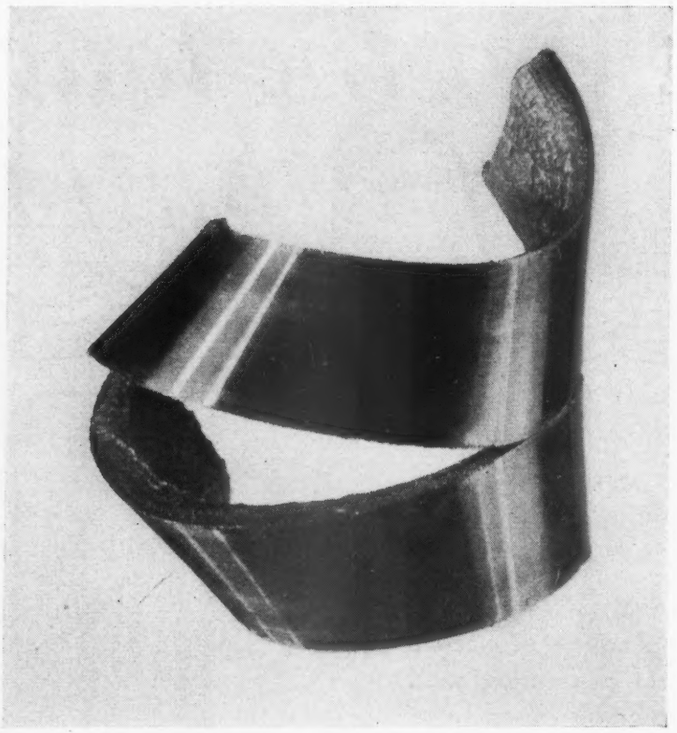
TUNE IN THE WESTINGHOUSE SALUTE OVER THE N. B. C. NATION-WIDE NETWORK EVERY TUESDAY EVENING.

It Takes Timken Equipped Spindles To Make Cuts Like This!



Look at the beautiful surface of that steel turning—as sleek and glossy as though it had been polished—with not a single chatter mark to mar its satiny smoothness!

The illustration shows a typical chip turned off on the Reed-Prentice 16″ Heavy (20″ Standard) Lathe with Timken Bearing Equipped spindle.

It was made from an unretouched photograph, and is a splendid example of the kind of work that is being regularly accomplished on modern Timken-equipped machine tools.

Here are the working conditions under which this cut was made. Material, Nickel-Chromium Steel (S.A.E. 3140). Analysis: Carbon .35-.45, Manganese, .50-.80, Nickel, 1.00-1.50, Chromium, .45-.75. Diameter of bar, 3¾″. Spindle speed, 38 R.P.M.—37 feet per minute. Depth of cut, ¾″. Feed, .112. Horse power required, 24.8. Cutting inches, per minute, 29.8.

And not only *better* work, but *more* work results from the permanent spindle rigidity made possible by Timken Bearings through Timken tapered construction, Timken positively aligned rolls and Timken-made steel. Speeds can be higher. Cuts can be heavier. Advantage can be taken of the new tool alloys to the limit of their capacity. That is the basis of Timken dominance on spindles throughout the machine tool industry. The Timken Roller Bearing Company, Canton, Ohio.

TIMKEN *Tapered Roller* **BEARINGS**

MINIATURE PORTABLE A.C. TEST SETS . .

For Servicing Small Apparatus

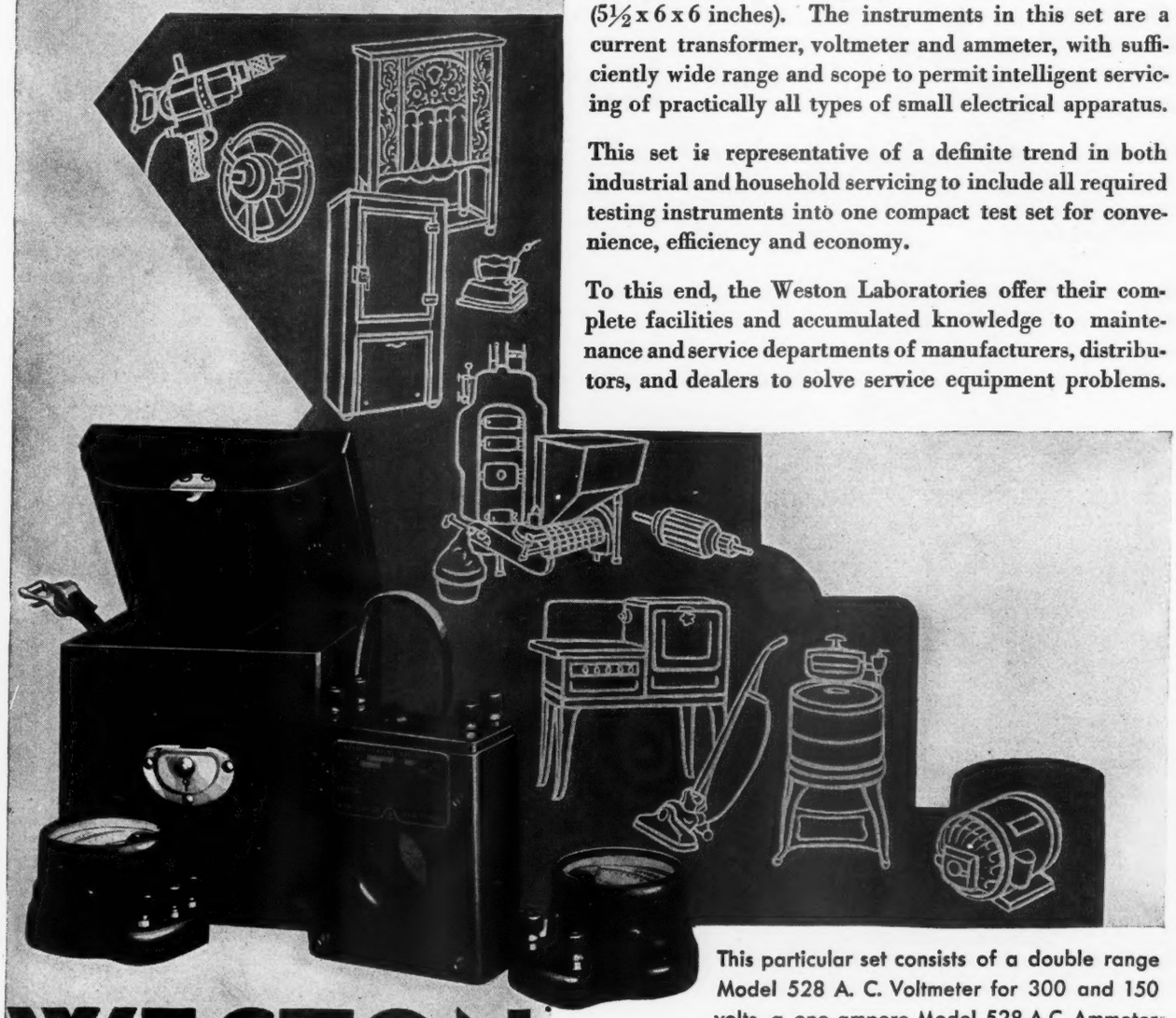
TODAY, with electrical time and labor saving apparatus becoming a household as well as an industrial necessity, there has arisen the need for economical electrical testing equipment to cope with the service problem.

For years the Weston organization has developed specialized test sets to suit the particular requirements demanded for these many different types of service.

Illustrated on this page is a typical Weston test set. This particular one is recommended for industrial plant use and field service work. The set is unusually light (5.8 pounds) and compactly fits into a leather case (5½ x 6 x 6 inches). The instruments in this set are a current transformer, voltmeter and ammeter, with sufficiently wide range and scope to permit intelligent servicing of practically all types of small electrical apparatus.

This set is representative of a definite trend in both industrial and household servicing to include all required testing instruments into one compact test set for convenience, efficiency and economy.

To this end, the Weston Laboratories offer their complete facilities and accumulated knowledge to maintenance and service departments of manufacturers, distributors, and dealers to solve service equipment problems.



This particular set consists of a double range Model 528 A. C. Voltmeter for 300 and 150 volts, a one ampere Model 528 A.C. Ammeter and a Model 539 Current Transformer.

The instruments are completely self-contained. The Current Transformer, when used with one ampere instrument, permits measurements from 0.2 to 200 amperes. The instruments are encased in mottled red and black Bakelite cases.

For a more complete description write for circular D.S. 528-539.

WESTON
ELECTRICAL INSTRUMENT CORPORATION

597 Frelinghuysen Avenue . . . Newark, N. J.

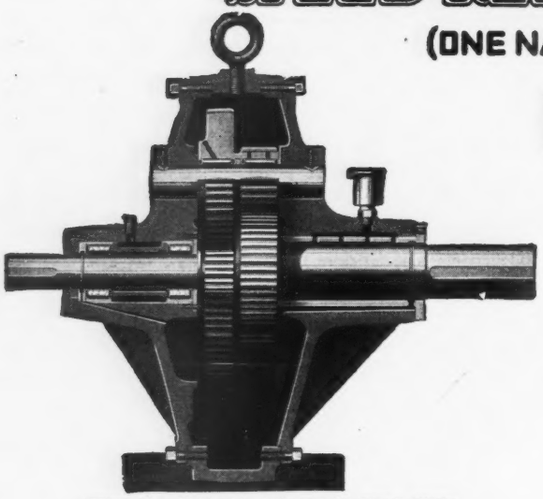
A Straight Line Drive For Large Reductions in Speed

Philadelphia

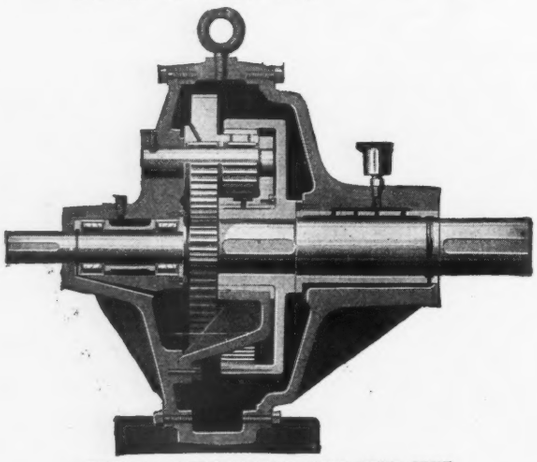
SPEED REDUCING UNITS

(ONE NAME-ALL TYPES)

Ratios up to 450:1



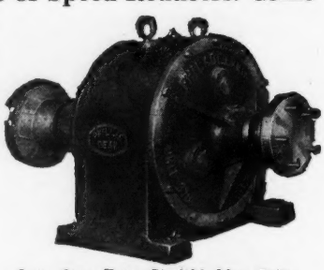
TYPE M-1 PHILADELPHIA SPUR GEAR UNIT. All high speed elements operate on ROLLER BEARINGS. The Spur Gears are of Chrome Vanadium Steel, properly heat treated for resistance to wear and shocks. Oil leakage in both this Unit and the Type R-1, is eliminated by the use of Oil Drains on both high and low speed shafts.



TYPE R-1 PHILADELPHIA SPUR GEAR UNIT. Practically the same as the Type M-1, excepting the substitution of an internal gear for the driven gear in the Type M-1, which allows a greater speed reduction. The slow speed shafts on both types are provided with Oil Cups directly over the bearings; in larger sizes the bronze bushing is ring oiled.

These Philadelphia Units are available in any ratio from 1:1 up—depending on the type (M1-M2-M3-etc.). Splash back lubrication is provided in all types—yet oil leakage is positiviely prevented. Pinions and gears are Alloy Steel, heat treated, hardened. Roller bearings on high speed shafts, Phosphor Bronze Bushings on low speed.

These details are typical of Philadelphia Construction throughout ALL types of Speed Reducers. Come to us for unbiased advice as to which type will suit you best—and GET the one exactly suited to your needs — an important consideration.



Spur Gear Type—Straight Line Drive. Spur Gear Reduction Unit—Straight line drive—with all high speed elements revolving on roller bearings, ensuring high efficiency gears and pinions properly heat treated for resistance to wear and shocks. Oil leakage is eliminated by the use of oil drains on both high and low speed shafts.

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Just out. Covers all types of Speed Reducers in detail —blueprints, diagrams, tables, etc. Send for your copy today.

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Power Saving Products

GEARS, Spur Worm, Herringbone, Internal, Bevel, Miter, Intermittent, Spiral, Helical Continuous, Tooth Herringbone Spiral Bevel Gears. NON-METALLIC PINIONS: Fabroil, Textolite, Rawhide.

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ON November 1, 1930, the sales and service facilities for Gredag Lubricants, well known and long established products of the Acheson Graphite Corporation—a Unit of Union Carbide and Carbon Corporation—were greatly extended.

Gredag Lubricants are now being sold and distributed by the Carbon Sales Division of National Carbon Company, Inc.,—a technical organization which for many years has been in constant contact with industrial plants and distributors of industrial products.

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Unit of Union Carbide UCC and Carbon Corporation

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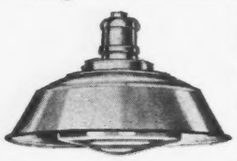
NEW YORK · PITTSBURGH · CHICAGO · BIRMINGHAM · SAN FRANCISCO

Skilled hands are shackled by the Twilight Zone*

THE sure touch and quick comprehension of the trained workman are wasted in the twilight zone. For partial darkness can result only in partial efficiency. The half-light of the twilight zone deceives because it promises the freedom that only correct lighting can give... without indicating that many of the handicaps of darkness are still present.



Remove the handcuffs of twilight zone illumination under which 87% of American factories operate. Provide the help and the incentive to greater efficiency that comes with lighting scientifically planned and correctly installed.

On MAZDA Avenue

In the Westinghouse Lighting Institute a fully equipped factory scientifically demonstrates every type of industrial lighting —

Open to visitors

Daily 9 to 5 — Saturday 9 to 12
7th Floor, Grand Central Palace, New York City
—around the corner from your hotel

You will find in the Westinghouse lighting specialist a man who understands thoroughly how to help you make your lighting pay you a profit. Let one of these trained men show you how lighting can serve you more efficiently.

The way out of the Twilight Zone

For those interested in using light effectively an interesting, illustrated booklet, "The Way Out of the Twilight Zone," is available. Write for a copy to the Westinghouse Lamp Company, Department 203, 150 Broadway, New York, N. Y.

**The deceptive half-light between obvious darkness and adequate illumination.*

Westinghouse Lighting Specialists will help you plan an effective lighting system

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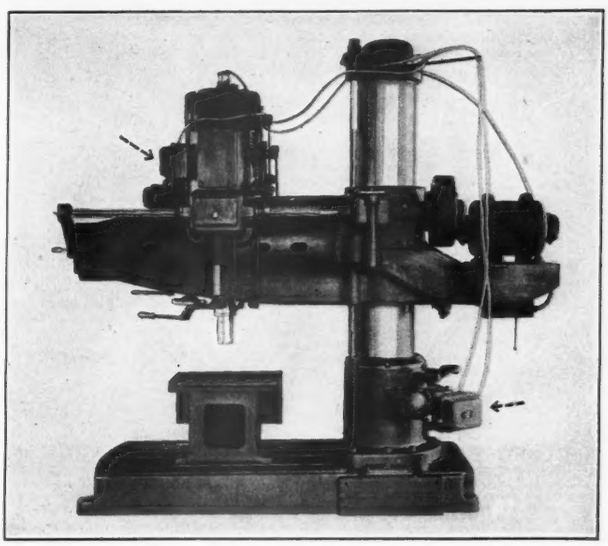
Instantaneous and Positive...

Monitor did it with Reversing Controllers

Monitor Mechanically-Interlocked Three-Pole Reversing Controller.

THIS radial drill must work fast and its control must be precise. One Monitor Reversing Controller clamps and unclamps the radial work-head and the other runs the tool-head forward and reverse.

Wherever there is an electrical reversing action . . . reversing rotation, hoisting and lowering, clamping and unclamping... there is a Monitor Reversing Controller that will meet the exact requirements of the job. All Monitor Controllers are custom built with Monitor standardized parts.



• ● •

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IF YOU HAVE A CONTROL PROBLEM... CONSULT MONITOR

Monitor *does it automatically*

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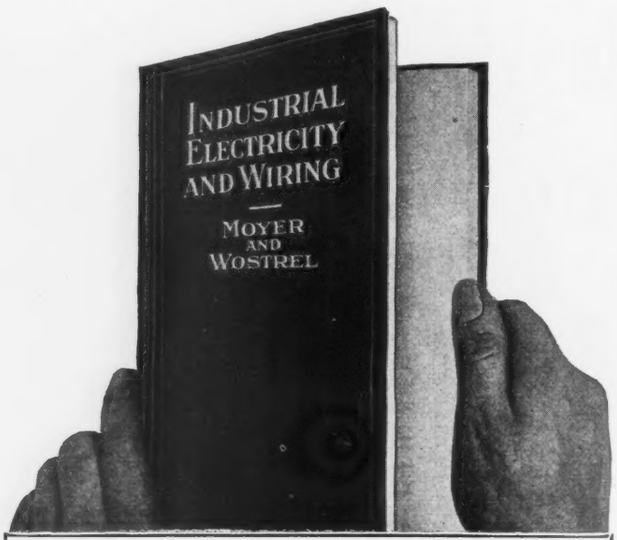
Standard wiring methods for every industrial purpose



Industrial Electricity and Wiring

By JAMES A. MOYER

Director of University Extension, Massachusetts Department of Education.

and JOHN F. WOSTREL

Instructor in Electrical Engineering and Supervisor in Charge of Industrial Subjects, Division of University Extension, Massachusetts Department of Education.

469 pages, 5½x8, 281 illustrations and diagrams, $2.75

THIS up-to-the-minute book meets an immediate need of electricians, wiremen, contractors, architects, servicemen and electrical engineers.

It outlines practical, economical, and thoroughly efficient methods of workmanship in accordance with the National Electric Code. It includes a description of the action and application of electrical apparatus including: generators, motors, and transformers. The increasing importance of theatre wiring, not only for stage and auditorium illumination, but for new scenic lighting effects and projection room equipment, is adequately discussed in this important work.

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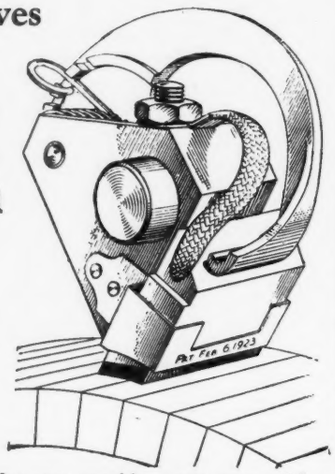
Rid your motor

of destructive sparking hot commutators, noise and brush grooves

Equip with

Reaction Brush Holders at our risk



Upon receipt of data for any machine you may wish to equip, we will furnish Reaction Brush Holder Equipment complete and ready to install, final acceptance being subject to satisfactory operation.

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Over 20 years in Service

Brings packages to car—takes curve at door—delivers them to far end of car, waist high.

CLARK'S CAR LOADING KIT

Greatest advance in car loading and unloading equipment in 50 years. Eight short sections, added to standard TwinVeyor line, loads first one end of car, then opposite end, then center section. Handles any packaged freight. Unloading just as rapid. A power head, at the warehouse end, keeps twin spiral tubes turning toward each other — the load rides easily, smoothly, swiftly.

For instance, bags travel 90 ft. per min., 1800 bags per hr.

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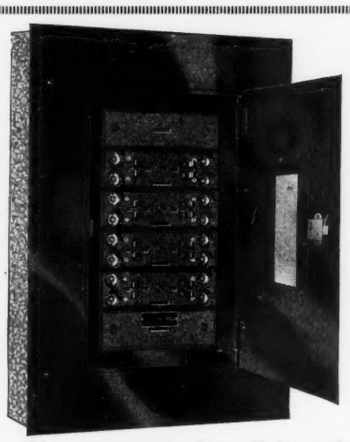
FOR 36 years, Cling Surface has been eliminating slipping belts, hot bearings, frequent belt take up, excessive lubrication and belt-wasted power in every industry. You are now invited to try Cling Surface entirely at our risk.

Send for a 60-day supply. Apply quickly and easily and note how your belts gain new elasticity, new clinginess. Note how belt slip ceases. After you have proved this to yourself, pay us these trifling prices: 1 gal. at $3.50; 3 gal. at $3.40 per gal ; 6 gal. at $3.25 per gal.—if not satisfactory, you owe us nothing. Send no money, just tell us whether your plant conditions are cold, dusty, dry or the reverse and how much to send. Cling Surface Co., 1042 Niagara St., Buffalo, N. Y.

Cling-Surface
FOR BELTS

CS-20



Your factories *must* run

Your men must have light and power constantly or production stops. When production is interrupted—profits disappear. You can depend on FA Panelboards. Requiring no-maintenance they give service as long as the building stands. There are reasons—many of them.

Panelboards are the Sign of a "no-interruption" Job

Talk to an FA man for help on your panelboard and switchboard problems. There is one near you.

Frank Adam
ELECTRIC COMPANY
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There are FA offices in all principal cities

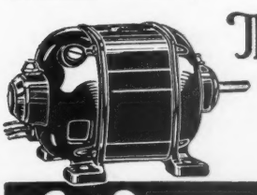
RECAPITULATION

HOW few of us ever stop to consider to what lengths electrical and mechanical science has progressed since Galileo, Keplar and Newton laid down the Basic laws . . . since Franklin's momentous discovery!

What wonders have since been worked . . . what truly remarkable methods have been employed to harness electrical force!

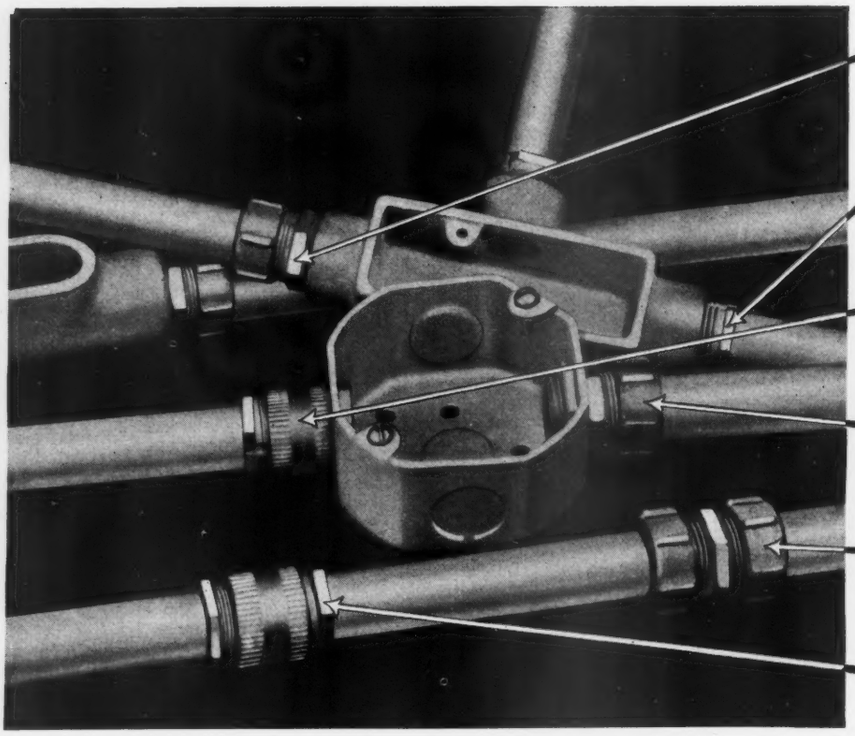
Consider, for instance, the measure of electrical skill and ingenuity represented in the modern electric motor. Consider the comparative merits of modern mechanical designs, and it is evident that the Leland Motor is pre-eminently representative of the remarkable strides made in electrical and mechanical science.

A.C. Repulsion Induction
D.C. Compound Wound
A.C. Polyphase
All in interchangeable frames



The Leland Electric Co.
Dayton·Ohio
U·S·A

Leland Motors



Vaporproof connector for joining STEELTUBES to standard threaded fittings.

Standard adapter for joining STEELTUBES to Standard threaded fitting.

Standard connector for joining STEELTUBES to knock-outs in boxes and panels.

Vaporproof connector for joining STEELTUBES to knock-outs in boxes and panels.

Vaporproof coupling for connecting lengths of STEELTUBES.

Standard coupling for connecting lengths of STEELTUBES.

Takes All Fittings

No Threads to Cut . . .

STEELTUBES (E.M.T.)* gives you a choice of two types of fittings . . . standard and vapor-proof. Both are shown in the illustration above.

This thin-wall conduit assures you of a workmanlike job . . . the kind that will help you get new wiring contracts. It bends easily . . . cuts easily . . . is easy to fish wire through . . . and there's no threading.

Electrical Division
STEEL AND TUBES, INC.
Cleveland, Ohio
(A Unit of Republic Steel Corp.)

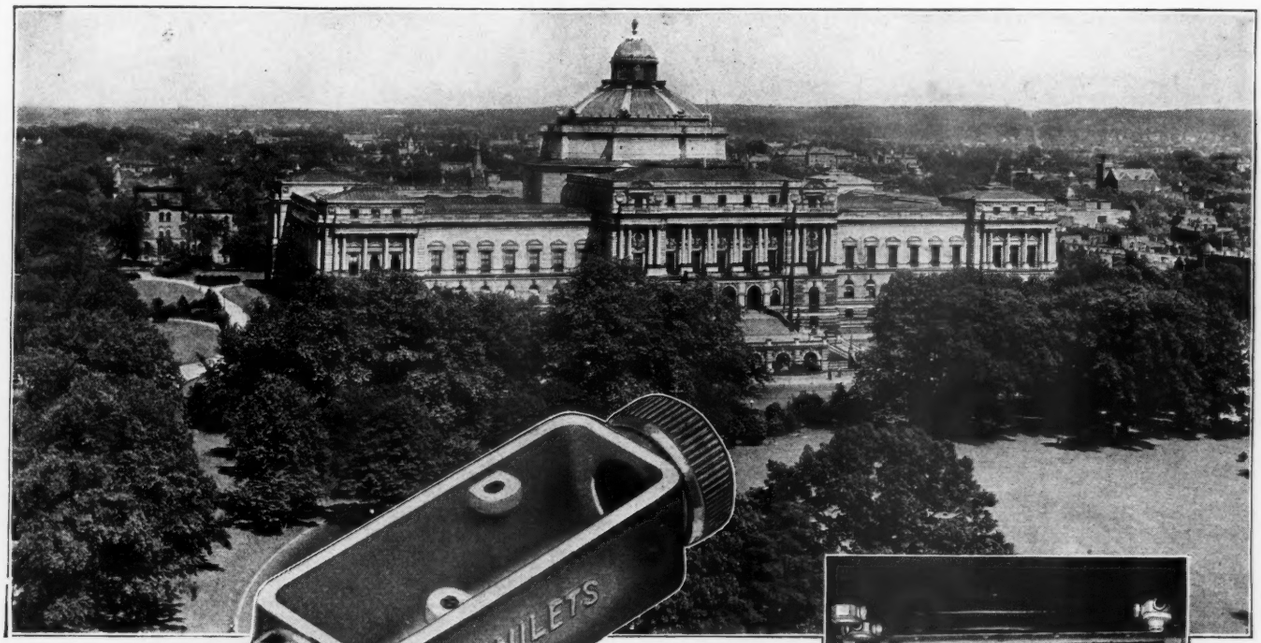
*STEELTUBES Electrical Metallic Tubing is threadless, strong, light and easy to handle. Costs less to buy. Saves time and money on the job.

Steeltubes

STEELTUBES [E.M.T.]* has the same inside diameter as heavy conduit. Made in three sizes (½", ¾" and 1") with outside diameter and wall thickness shown above. One coupling furnished with each ten-foot length.

STEELTUBES carries the Underwriters' Label, and is approved and listed as Standard by the Associated Factory Mutual.

Appleton Unilets in Famous Buildings



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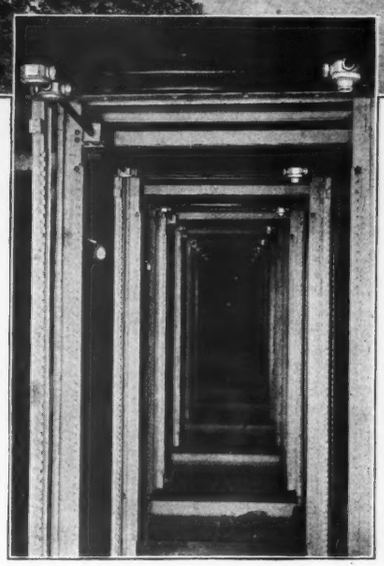

MANY of the most beautiful buildings in the United States are equipped with Appleton No-Thread Unilets. The Congressional Library at Washington, illustrated above, shows an installation of Appleton No-Thread Unilets in this famous building.

Malleable iron gives Appleton No-Thread Unilets great strength with lighter weight, there is maximum wiring space inside, and the cadmium coating insures the greatest rust resistance.

Our new general catalog has complete information on Appleton No-Thread Unilets, as well as the entire Appleton line. Write for it today.

Appleton No-Thread Unilets are listed as Standard by Underwriters' Laboratories in ½-inch to 4-inch sizes, inclusive

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The Original Threadless Conduit Fittings

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Please send us a copy of New Revised Catalog on Unilets and Conduit Fittings, together with prices.

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Address .....

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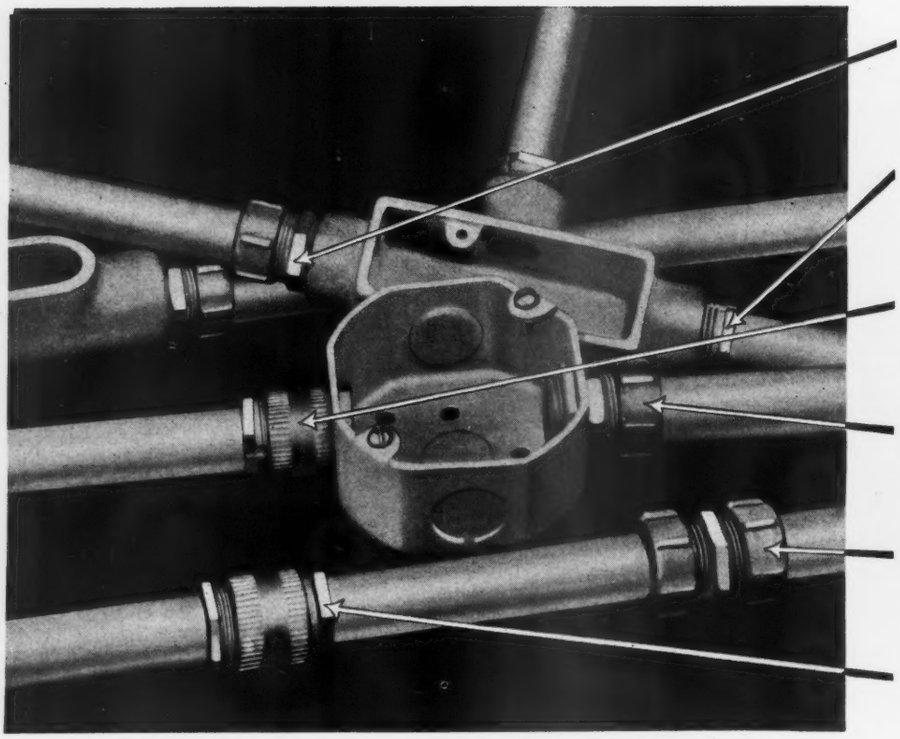

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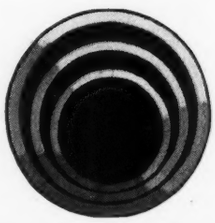

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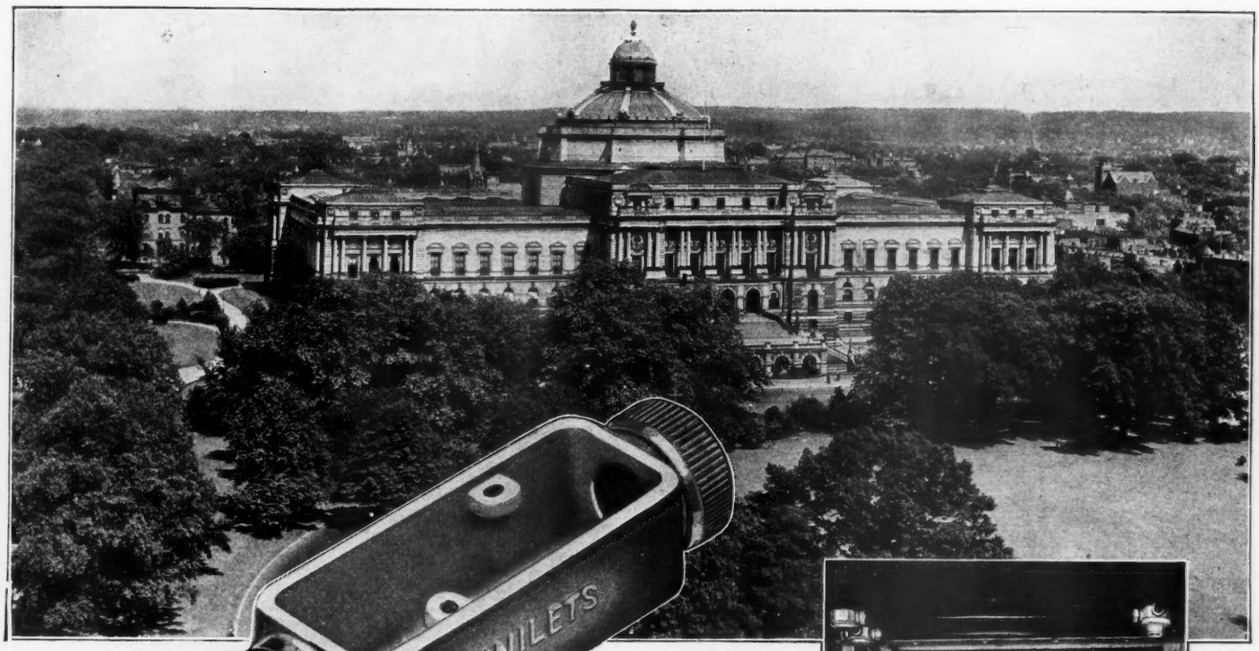

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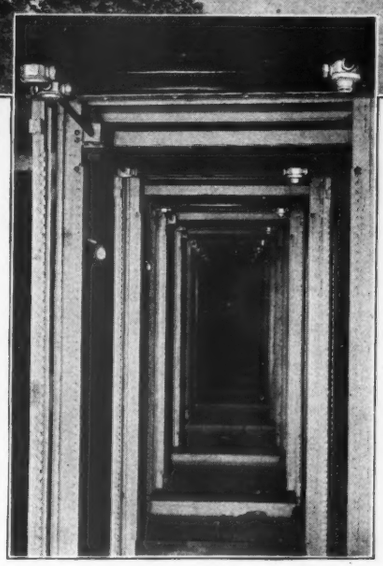

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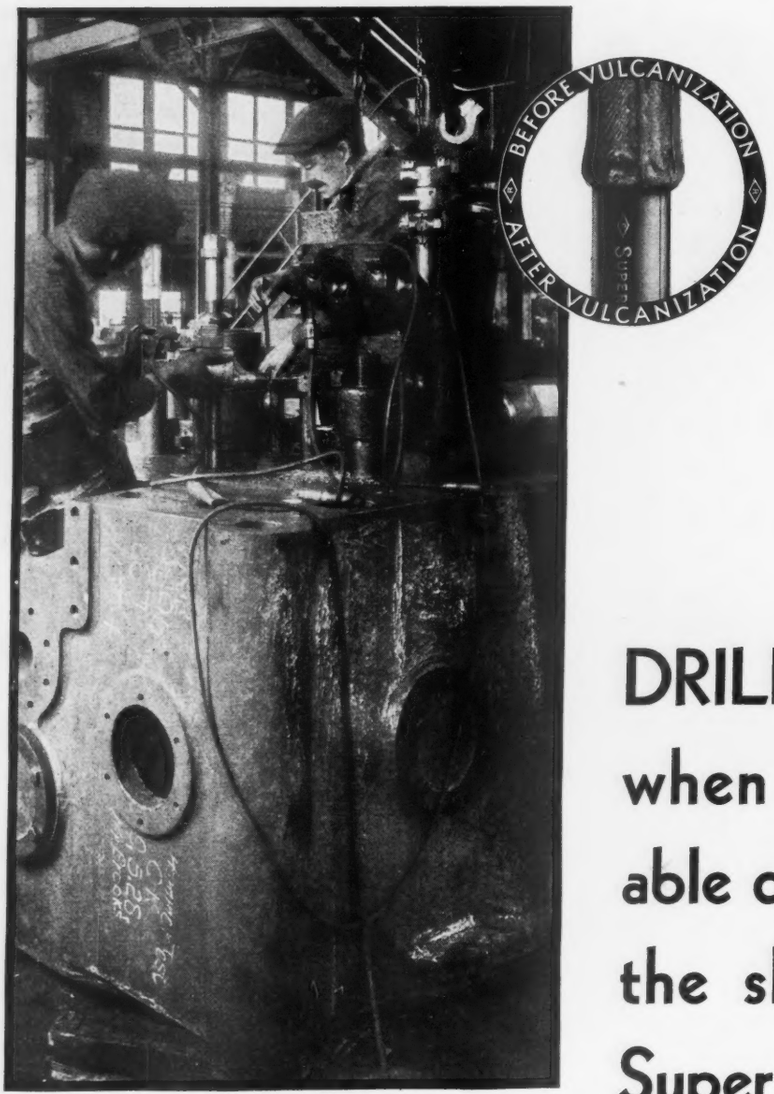

DRILLS, lamps, tools—when you need portable cords, anywhere in the shop—use Rome Super Service. Its tough rubber jacket is vulcanized under terrific pressure in steel molds. That makes it waterproof and highly resistant to oil or acid. Drag it around—it stands the worst abrasion. Yet it's more flexible, kink-proof, easier to handle.

GENERAL CABLE CORPORATION

EXECUTIVE OFFICES: 420 LEXINGTON AVENUE, NEW YORK • OFFICES IN PRINCIPAL CITIES

10 CRANES equipped like this!

Clark "3C" Vari-Time Magnetic Controllers for Cranes

Proof by trial is conclusive

Repeat orders duplicating the above illustrated installation give indisputable evidence of the merits of Clark Crane Control equipment Hoist, Bridge and Trolley all controlled by Clark.

Write for Bulletin 114.

THE CLARK CONTROLLER CO.

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De Laval Worm Gears

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make possible the use of standard high speed motors regardless of head and delivery relations. Each of these 4-1/8 ratio gears transmits 50 hp. from a 1170 r.p.m. motor to a vertical shaft trash pump in the Jacksonville, Fla., sewage system.

De Laval Steam Turbine Co., *Trenton, N.J.*

Roller-Smith

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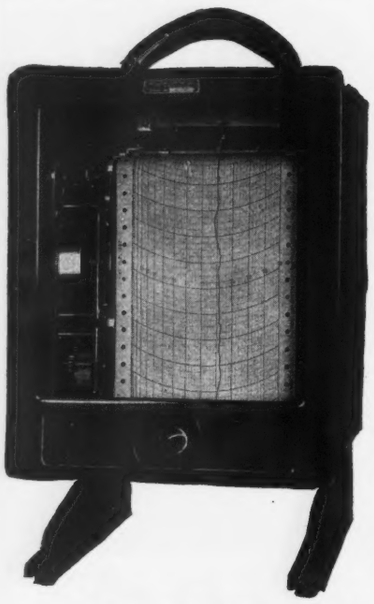

IN the short time since then the many outstanding features of this new line have been recognized and appreciated by many very particular engineers and large numbers of R-S Graphics are giving fine service under all sorts of trying conditions.

The line comprises switchboard, portable and wall models, A.C. and D.C., ammeters, voltmeters, wattmeters, power-factor meters and special devices for special applications.

Send for your copy of Bulletin No. A-830.

Forty years' instrument experience is back of

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MAIN OFFICE: 229 Broadway, NEW YORK
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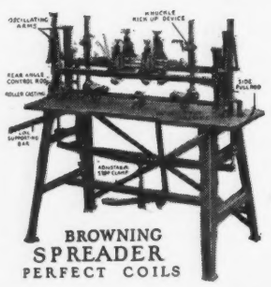
BROWNING
Coil Equipment



Let us Assist with Your Coil Problems.

Costs Reduced

25 to 40%

Replace your obsolete coil making equipment with modern time saving Browning machines. Perfectly formed coils cut winding costs.

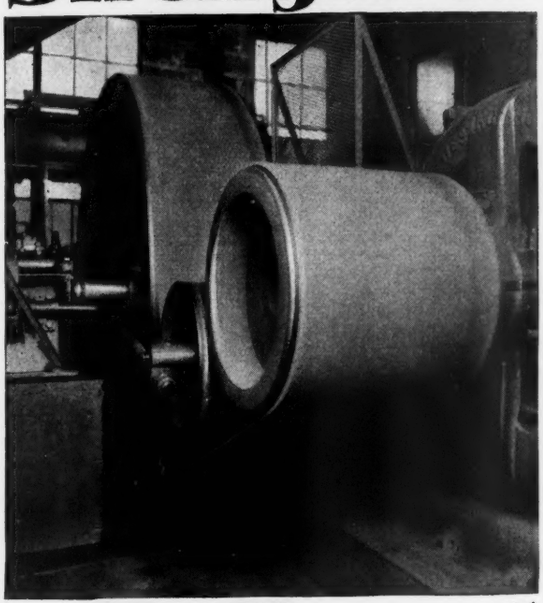
Browning equipment is now standard with the largest motor manufacturers' service shops, also leading repair shops and industrial plants.

Write for information on our complete line of equipment.

Specialists in Coil-Winding Machinery

Mutual Foundry & Machine Company
Atlanta, Georgia

Strength or



Pulling Power?

If you want strength for tension we unhesitatingly recommend a *steel* belt. It is far stronger than fabric, rubber or leather and will lift more.

If, on the other hand, you want pulling power, we unhesitatingly recommend VIM. It has greater surface adaptability, pliability and resiliency than fabric, rubber or leather. These features are backed by exceptional fiber strength, making an ideal combination of necessary qualities found in no other belting now on the market.

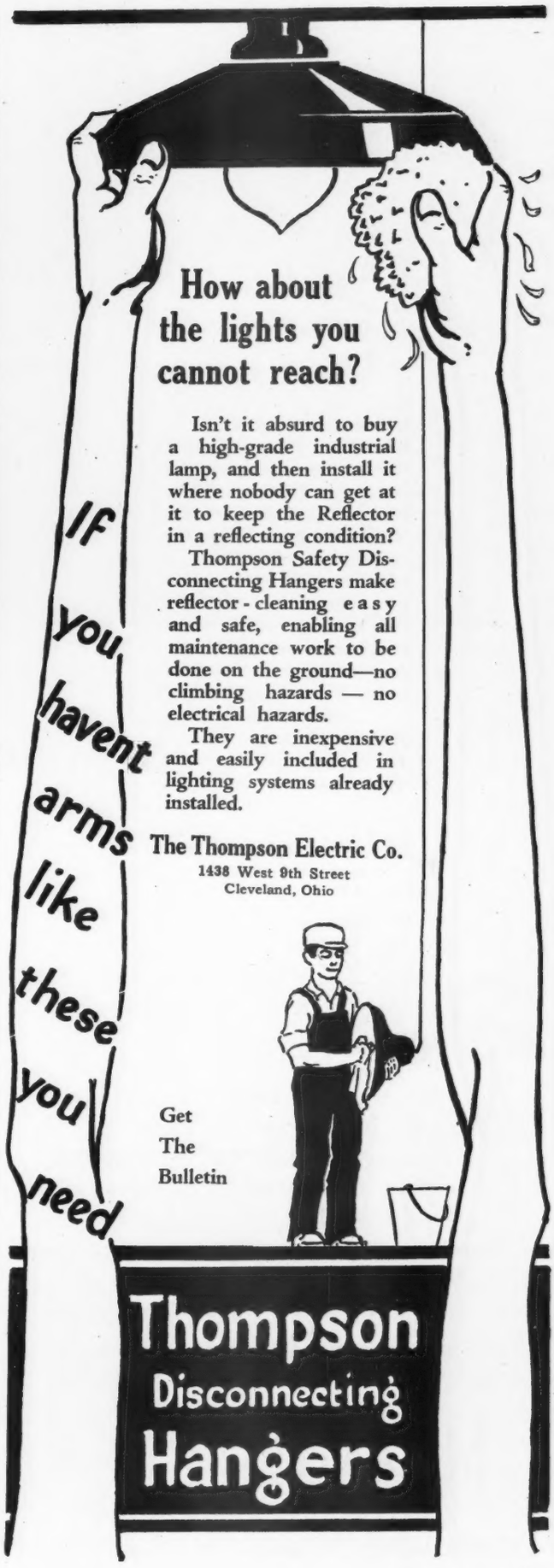
Because of these properties, VIM Leather Belting can be operated at low tension, thereby insuring longer belt and bearing life—lower power consumption —and lower maintenance costs.

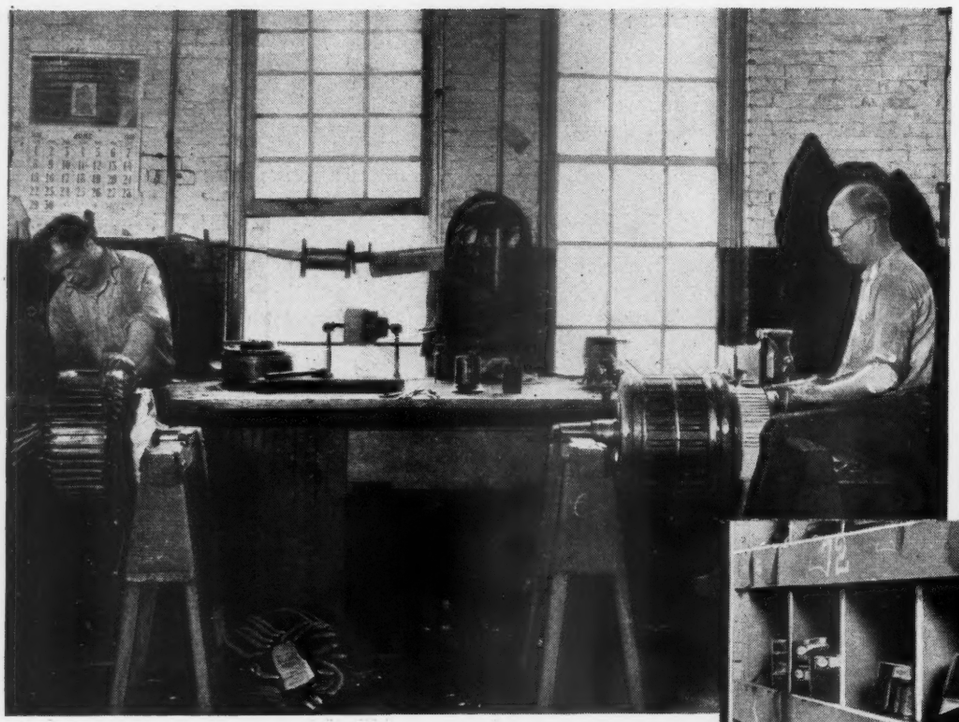
E. F. Houghton & Co.

Philadelphia, Penna.

VIM LEATHER will outpull any other belting material made MAKE US PROVE IT

And All Over the World


If you havent arms like these you need
How about the lights you cannot reach?
Isn't it absurd to buy a high-grade industrial lamp, and then install it where nobody can get at it to keep the Reflector in a reflecting condition?
Thompson Safety Disconnecting Hangers make reflector-cleaning easy and safe, enabling all maintenance work to be done on the ground—no climbing hazards — no electrical hazards.
They are inexpensive and easily included in lighting systems already installed.
The Thompson Electric Co.
1438 West 9th Street
Cleveland, Ohio
Get The Bulletin
Thompson Disconnecting Hangers



A reserve of Mica Insulator Company products at the Monongah Mine warehouse.

Dependable insulation *is the demand of Consolidation Coal*

Repairing locomotive and power motor armatures; reconditioning transformers and other electrical equipment requires insulation that can withstand severe service. That's why Consolidation Coal is such a large user of Mica Insulator Company insulations. The superintendent of maintenance at the Monongah Mine has characterized these materials as "The best we know of."

In the commutators, Super-Micanite segments and rings promotes motor performance. It has greater dielectric and mechanical strength; does not carbonize and forms no corrosive decomposition products. Because of its density, Super-Micanite assures uniform spacing of commutator bars.

Empire Oiled Cloths, Seamless Bias Tapes, Varnishes and other performance proved insulations are described in detail in Catalog No. 87. Write for a copy.

MICA INSULATOR COMPANY

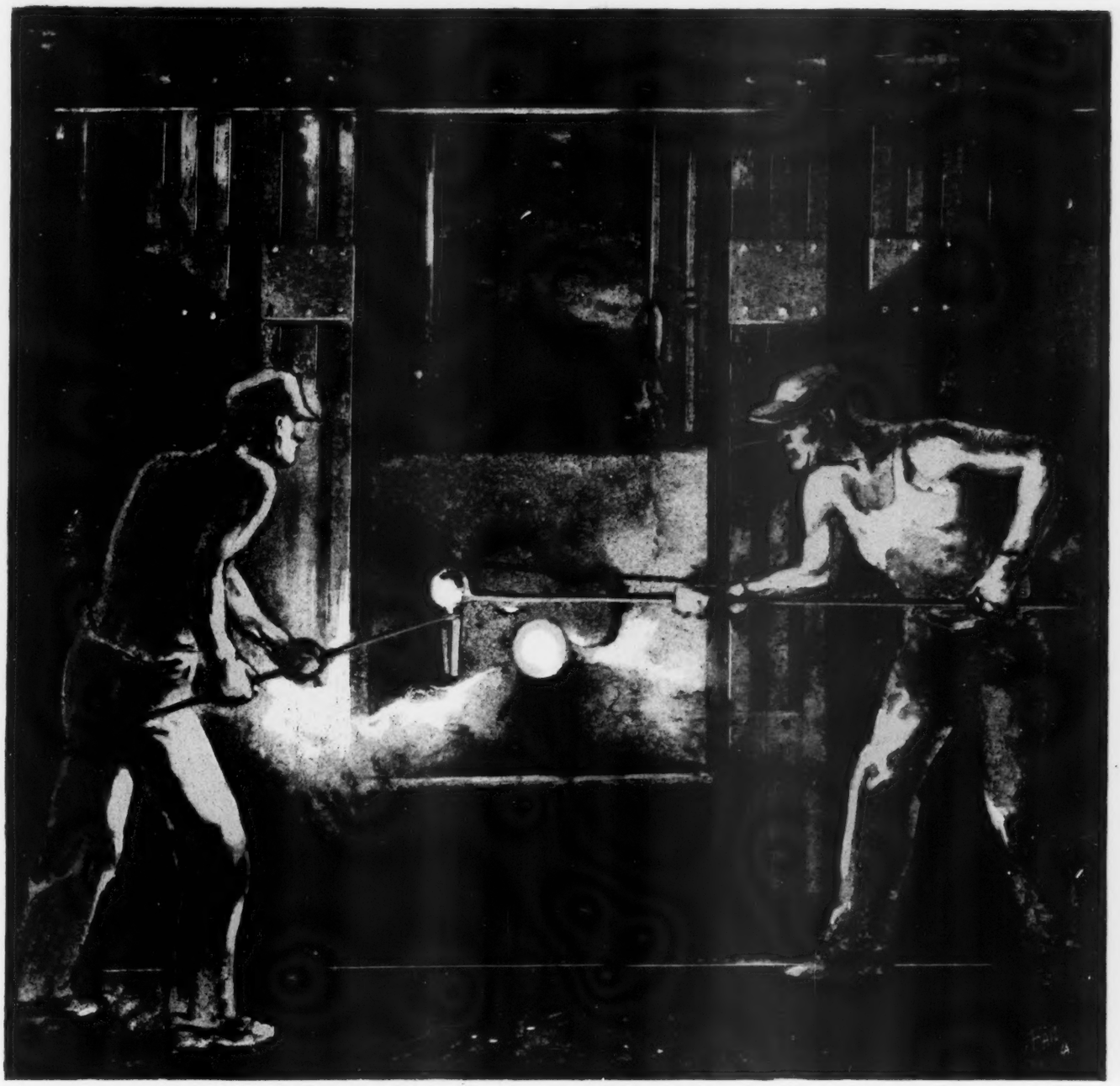
New York: 200 Varick St. Chicago: 542 S. Dearborn St. Cleveland Pittsburgh Cincinnati San Francisco Seattle Birmingham Los Angeles Montreal and Toronto, Canada Works: Schenectady, N. Y. London, England

PERFECT MICANITE INSULATOR REG. U.S. PAT. OFF.

Electrical INSULATION

PERFECT EMPIRE INSULATOR REG. U.S. PAT. OFF

MICA INSULATION OILED CLOTH INSULATION

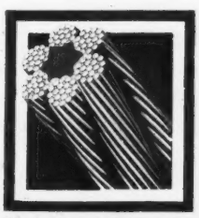


Sampling a melt of Roebling Acid Steel
for laboratory check

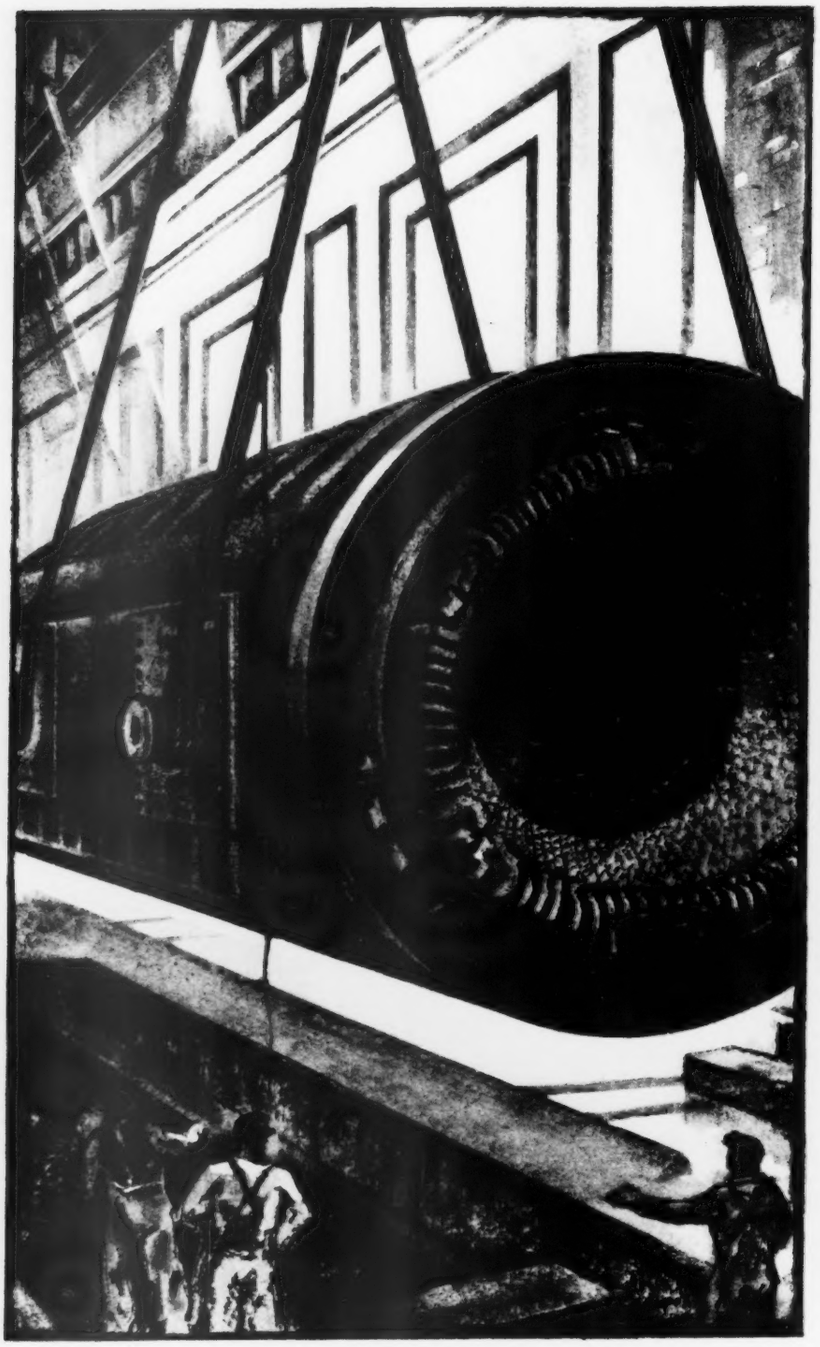
WATCH the open-hearth furnaces in the Roebling steel mill and you will see the pictured procedure repeated time and time again. It is sampling the melt for a chemical check in the laboratory.

Wire rope can be no better than the steel of which it is made. For Roebling "Blue Center" Wire Rope the acid steel must measure up to exceedingly high standards. Its quality is closely controlled in small open hearth furnaces, and it is repeatedly subjected to a careful chemical check.

Hundreds of thousands of feet of Roebling "Blue Center" Steel Wire Rope are produced yearly by the most modern of production methods. But it is old-fashioned thoroughness that protects its quality every step of the way.

ROEBLING  **WIRE ROPE**

"BLUE CENTER" STEEL



WHEN
$1,500,000
hangs in the balance

. . . safety must rule!

A FORTUNE is tied up in this gigantic 395 ton stator of the 160,000 K. W. generator for the N. Y. Edison Co. Hoisting it, and then safely lowering it into place, was a job to be entrusted only to a rope whose mettle was above suspicion—to Roebling "Blue Center" Steel Wire Rope.

There are sound reasons for the confidence which engineers place in Roebling Rope. Its production is controlled with scrupulous care every step of the way, from furnace to shipping room. Old-fashioned thoroughness prevails throughout the Roebling mills—it is the creed of every department.

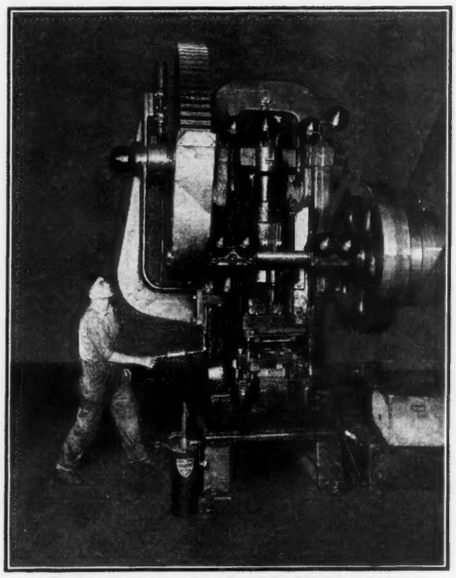
JOHN A. ROEBLING'S SONS COMPANY
WIRE...WIRE ROPE...WELDING WIRE...FLAT WIRE
COPPER *and* INSULATED WIRES AND CABLES
TRENTON, N. J. *Branches in Principal Cities*

ROEBLING **WIRE ROPE**

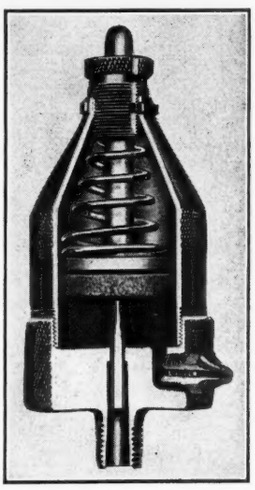
"BLUE CENTER"
STEEL

? WILL YOU MAKE THIS LUBRICATION TEST

entirely at our expense



Punch Press equipped with Alemite Automatic Cups, filled from a convenient position by means of tubes leading from a centralized, easily accessible location.



For the bearing which requires a constant flow of lubricant, use Alemite automatic cups (adjustable).

BECAUSE lubrication plays such an important and vital role in the achievement of a high standard of factory efficiency, we know you will be interested in our story.

Because Alemite High Pressure Systems of lubrication have proved so successful in scores of factories and plants, we ask you to make a test in your own factory, at our expense.

It is much fairer to ask you to act on your own findings than on our recommendations.

The test is simple to make. Our engineers and test men assist you. It requires no "lay-up" of machines. And it will give you as it has done other managers and superintendents, the facts on lubrication as you would see them under no other conditions we know of.

After all, a comparison reveals facts as nothing else does. It will show for you in black and white whether the Alemite High Pressure Lubrication System will produce results in your plant similar to the far-reaching savings both in machinery repairs and the cost of lubrication which it has saved in other plants.

We have data proving that machinery repairs are reduced 80% and the cost of lubrication labor reduced 70%. So we unhesitatingly offer to make a test at our own risk.

Please send the coupon for further details and special cost sheets.

Alemite Corporation, (Division of Stewart-Warner), 2682 N. Crawford Avenue, Chicago.

ALEMITE

High Pressure Lubrication

ALEMITE CORPORATION (*Division of Stewart-Warner*)
2682 N. Crawford Ave., Chicago.

I want to conduct a lubrication test. Send me special cost sheets and information.

*Firm Name*_____ *Address*_____

*Individual's Name*_____

*City*_____ *State*_____

(310)

Avoid Strained Backs

and

Mashed Toes

What chance has one man, in moving a 900-lb. drum or barrel, to come off unhurt? It takes at least 3 men, by ordinary methods, to tip and drain a heavy container. And they may slip and sustain serious injury.

But with a Schwenk Tilter one man safely trucks, tilts, rotates and drains drums or barrels up to 900 lbs. capacity. The Tilter bears the weight, safely balanced and controlled.

For acids and chemicals in carboys, the Schwenk Carboy Tilter is the ideal safe pouring and trucking device.

Write for illustrated circular, with prices. Schwenk Tilters save their reasonable cost in remarkably short time. 2

Exclusive Export Representatives:
Whitehouse, Davis & Co., Inc.
27 Water Street, New York City.

THE SCHWENK "ONE MAN" SAFETY TILTERS

Schwenk Safety Device Corp.
70 E. 45th St.
New York

RIGHT LIGHT

means

better production
greater Safety
less spoilage
more contentment

"American" Adjustable Fixtures

put the light right where it's needed.

Many well-known plants have adopted "American" as standard. They have found these fixtures not only most efficient in performance, but very economical in first cost.

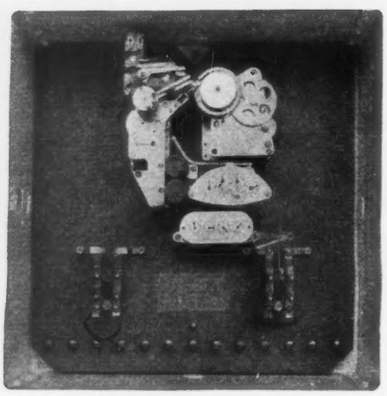
Get our catalog No. 6. It shows fixtures to fit every requirement

American Fixture Company

236 W. Water St. **Milwaukee, Wis.**

The
POWER DEMAND LIMUTER

REDUCES



DEMANDS

Eliminates the excessive and unnecessary peaks of the electric power demand automatically.

SIMPLE - RELIABLE

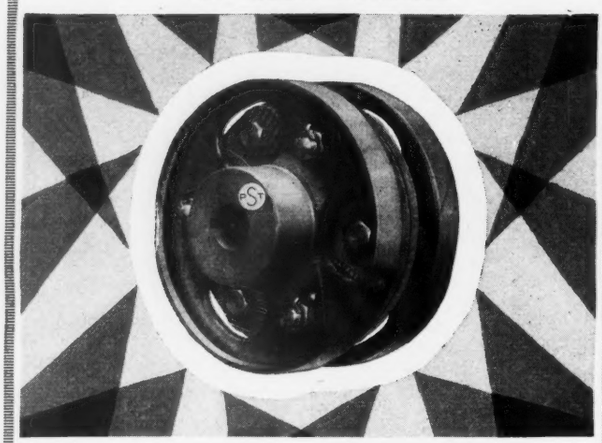
Write for Descriptive Bulletin

Manufactured By

STEELCITY FURNACE COMPANY

P. O. Box 1008 **Pittsburgh, Pa.**

PERFECT BALANCE
AT ALL SPEEDS



THE unusual shock absorbing capacity of **FLEXOID** Couplings practically eliminates vibration. Balance, at all speeds, is perfect.

Made from a specially designed flexible disc, **FLEXOIDS** are unaffected by water, oil or grease and require no lubrication.

FLEXOIDS sell for less, meet A. S. T. M. Safety Code requirements. Try them.

The Smith Mark Genuine (PST) *Shows It's a Flexoid*
Trade Mark

THE SMITH POWER TRANSMISSION CO.

1213 W. 3rd St., Cleveland, Ohio

"PB" Terminators

440-VOLT MOTOR INSTALLATION

A new device for sealing the ends of cables—preventing moisture from entering the spaces inside the lead sheath or braid.

On lead covered cables it affords a positive ground. On conduit it prevents entrance of moisture or dirt.

The extra protection to conduit and cable by the use of Type "PB" Terminators will earn, in the form of reduced maintenance costs, a high return on the small added investment.

May We Send A Copy of Bulletin 65-A?

Delta-Star Electric Co

2400 Block Fulton St. - - - Chicago

COVULC

halves maintenance expense on all conveyor equipment

COVULC—a new self-curing rubber compound—is used to resurface all types of worn conveyor equipment.

COVULC triples the life of present equipment and eliminates extensive replacements—keeps your plant on full time, because you can quickly make repairs after working hours.

We Can Prove It To Your Satisfaction

To find out the operating efficiency and big savings afforded by COVULC *in your plant, entirely without risk,* simply fill in the coupon. We will send you the COVULC booklet, describing COVULC in detail—and how you can apply COVULC to any worn belts, hoppers, chutes, etc. Two big Eastern corporations found COVULC tougher than boiler-plate.

THE HITCHCOCK COMPANY, INC.
Park Square Bldg., Boston, Mass.

Send me information on COVULC, the self-curing, plastic rubber compound.
We are interested in COVULC for use on
.....
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(NAME OF FIRM)
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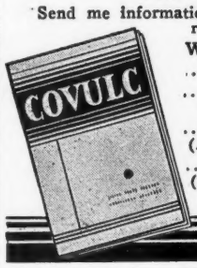
(ADDRESS) (CITY) (STATE)
.....
(SIGNATURE) (POSITION)

IE-12

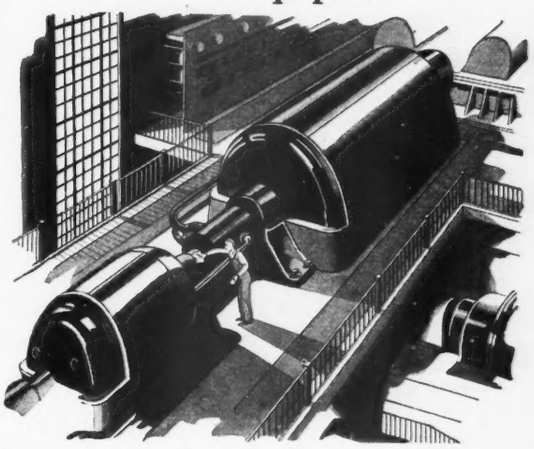


Thinking in the right material

The right workabilities, right functioning, right appearance, right possibilities for simplification of design, production, assembling and inspection. For some companies these have meant everything, for success against competition. Men who want ideas, for betterments and economies, should study closely every product in which NVF or Phenolite is used.

What they can learn

from Generators and modern Power Plant Equipment



HIGH speeds, high voltages, terrific pressures. . . . Think what properties a material must possess to withstand all of these destructive forces. Unusual properties you'll admit. In fact, so unusual that were it not for such materials as NVF and Phenolite these super-power plants would be an impossibility. Since the birth of commercial electricity, designers of generating and transmitting equipment have turned to National for materials whose dielectric and structural strengths are definite and calculable. With each year the demands upon these materials increase, yet each advance in design, each increase in size and output of the machines finds NVF ready with a formula that has anticipated the new specifications.

●

We make ten standard kinds of vulcanized fibre including Peerless Insulation and Leatheroid—for electrical insulation and for mechanical uses. We also make Phenolites (reinforced laminated bakelite materials) of many special formulae. Direct NVF representatives in principal cities of the United States, Canada and Europe.

NATIONAL VULCANIZED FIBRE CO.
WILMINGTON, DELAWARE

NVF

Every advancement, great or small, in ANY manufactured product, depends on

thinking in the right material

Standardize on BULL DOG

TO ELIMINATE WEAK LINKS IN YOUR WIRING SYSTEMS

We know what you're up against when you have to assemble a complete wiring system from a miscellaneous assortment of products.

Here's how you can overcome this difficulty:

Standardize on BULL DOG. By making up a complete wiring system with BULL DOG products you will be sure that every unit in the system is the finest that money can buy.

You will know that every part will function perfectly. You will achieve a performance record that only BULL DOG'S 28 Years of Research and Development could obtain.

Save yourself the time and trouble of replacing inferior products. Be sure of a lifetime of efficient operation from every unit. Standardize on BULL DOG. It's the most economical way in the long run. Let us send a BULL DOG salesman to help you figure your next wiring layout.

BULL DOG ELECTRIC PRODUCTS CO.
DETROIT, MICHIGAN

In Canada, Bull Dog Electric Products of Canada, Ltd., Toronto, Ont.

OVER 25 YEARS OF RESEARCH AND DEVELOPMENT

To engineers

AND . . .

Joseph Dixon Crucible Company
DIXON'S INDUSTRIAL PAINTS
Joseph Dixon Crucible Company
A FEW OF THE MANY NOTABLE STRUCTURES IN WHICH DIXON'S INDUSTRIAL PAINTS WERE SPECIFIED AND USED
Joseph Dixon Crucible Company
SPECIFICATIONS FOR DIXON'S INDUSTRIAL PAINTS (FLAKE SILICA-GRAPHITE)
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Dixon's Aluminum Paints
JOSEPH DIXON CRUCIBLE COMPANY
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The Company
How Dixon Discovered the Value of Flake Graphite As a Paint Pigment
MASTER SPECIFICATIONS
DIXON'S PAINTS
RED LEAD GRAPHITE PRIMER
BRIGHT ALUMINUM
INDUSTRIAL Silica Graphite
MAINTENANCE FLOOR
A-11 Fig. 252

. . . maintenance men

The set of Master Specifications herewith is the result of an effort to bring to you concise and reliable information on the subject of iron and steel paint protection. Its object also is to further advance the recognized claims of merit for flake silica-graphite paints in the submission of pertinent facts gathered in the century old career of the Joseph Dixon Crucible Company.

It is designed to simplify the problem of paint selection and to assist the engineer and maintenance man in a dependable way.

We confidently feel your filing cabinet will welcome it as a "member in good standing."

Ask for Master Specification No. 75-BI.

P.S. ***Requests for the Master Specifications will be met promptly. If two copies are required please so stipulate.***

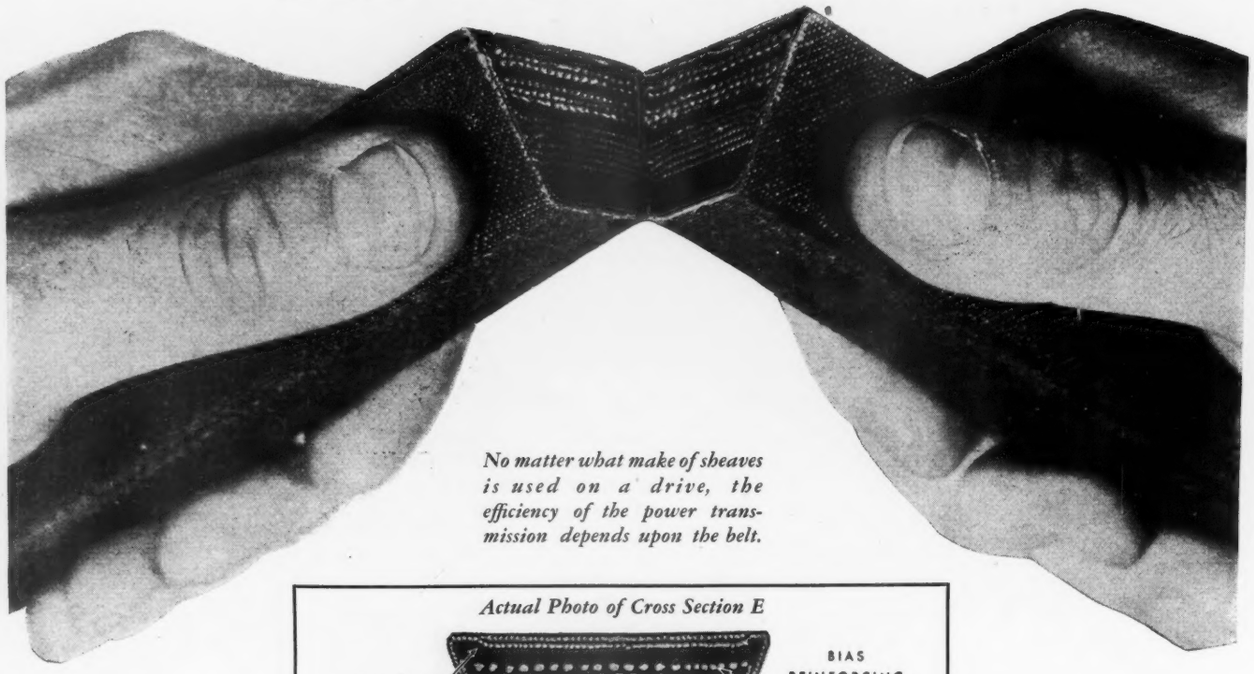
Paint Sales Division

JOSEPH DIXON CRUCIBLE COMPANY

Jersey City D X N TRADE MARK **New Jersey**

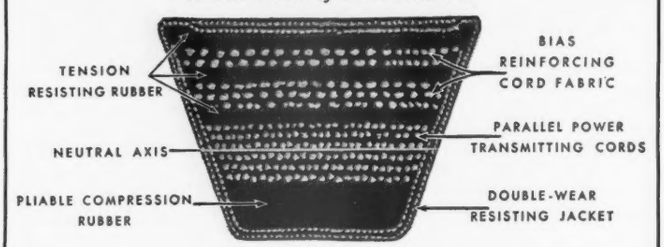
Established 1827

A V-Belt Drive is no Better than the Belt...



No matter what make of sheaves is used on a drive, the efficiency of the power transmission depends upon the belt.

Actual Photo of Cross Section E



Patented Construction

Here is an actual demonstration of the scientific design and construction that bring about Gilmer V-Belt superiority. Every detail is there for a specific purpose — Gilmer does not manufacture a drive. The very fact that the huge Gilmer V-Belt business is built on replacements of other belts speaks for itself.

When a V-Belt bends around a sheave the upper part is in tension, the lower in compression. At some point — *the neutral* axis — neither force is present. At this point, in every Gilmer V-Belt, will be found superimposed layers of unusually strong cords — *a feature originated by Gilmer engineers.* These cords transmit the load without stretching and without setting up internal friction.

Above and below these cords is tough wear-resisting rubber. The upper and tougher rubber is compounded for repeated bendings without deterioration, while the lower and more pliable is compounded to resist compression.

On large Gilmer V-Belts, bias reinforcement cords are added to provide lateral stiffening against buckling. The cords and rubber layers are surrounded by two outer-jackets of rubber impregnated, wear-resisting duck, which excludes foreign matter — The entire belt is vulcanized into one solid elastic mass that possesses maximum stamina and strength.

Since all Gilmer V-Belts are made in accurate metal molds, their dimensions and angles are invariably correct. And — because of their design and construction they *will not twist or buckle in the grooves.*

Gilmer V-Belts have earned an enviable reputation for PERFORMANCE — they have proved themselves in industry after industry — When you are offered Gilmer V-Belts you can be sure that one all-important problem in power transmission is solved — "Belts by Gilmer" means efficiency – plus. L. H. Gilmer Co., Keystone & Cottman Streets, Tacony, Philadelphia, Penna.

Gilmer

Makers of the World's Best-Known V-Belts

Patented Construction

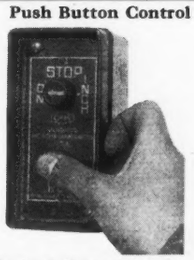
These PROTECTED MOTORS

MAKE MAINTENANCE EASIER . . . .

HELP KEEP . . . . PRODUCTION MOVING

Plant Engineers and Production Men have a common interest in this improved type of Reliance Motor. Primarily designed to lessen inspection, and maintenance it brings another and still greater advantage . . . . it sticks to the job longer and saves interruptions in the production line. The reason why, you can readily see. The vital parts are sealed against dirt, oil, fumes and moisture . . . trouble-makers in the best-made motor. The windings stay clean and dry. Nothing can get in to clog the air gap between rotor and stator.

Push Button Control



Enclosd Fan-cooled Reliance Motors in sizes 7½-30 hp. are the across-the-line type. Simple low-cost starters can be used. These are step savers.

No Larger than Open Motors

The method of cooling used by Reliance is so effective that these enclosed motors in most sizes up to 150 hp. are interchangeable in mounting dimensions with open motors of the same horse-power, and speed rating. This type of motor makes it possible to obtain the advantages of a dust-tight construction at a reasonable cost.

Get details from Bulletin 107

RELIANCE ELECTRIC & ENGINEERING CO.

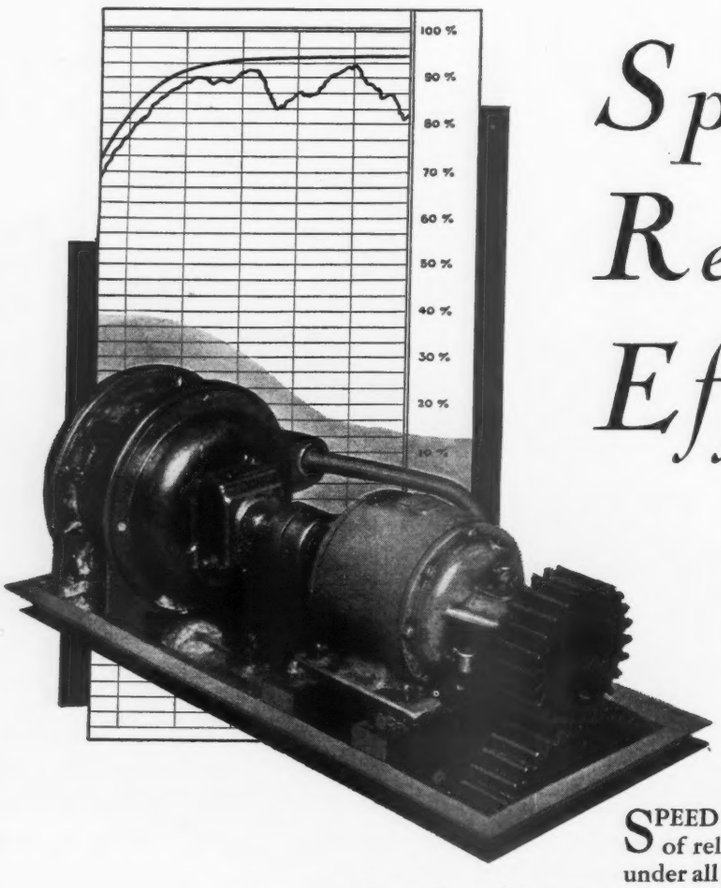
1051 Ivanhoe Road **Cleveland, Ohio**

Branches: Birmingham, Boston, Buffalo, Chicago, Cincinnati, Detroit, Milwaukee, New York, Philadelphia, Pittsburgh, St. Louis, Toledo.

Representatives: Denver, Kansas City, Mo., Knoxville, Los Angeles, Seattle, San Francisco.

RELIANCE A-C D-C MOTORS with Ball Bearings

How Do You Measure



Speed Reducer Efficiency?

SPEED Reducer efficiency is a matter of reliable, unvarying performance under all conditions of speed and load. Sharp peaks and valleys in operating efficiency caused by heat, friction, shock or overload mean increased power consumption and possible damage to motor or driven machine.

G & F Speed Reducers, when used as recommended by our engineers, will give highly efficient and unvarying performance under all reasonable conditions of operation. Their point of highest efficiency is quickly reached and continuously maintained. Due to proper mounting and careful alignment of gears and shafts, friction and heat are practically eliminated. Bearings and shafts are of ample size to carry heavy overloads. Gears are accurately cut from forged blanks supplied by our own forge division.

Let our engineers recommend the size and type of Speed Reducer, Worm, Planetary, or Herringbone, that will give you the most efficient service. Our line is complete . . . you may rely on our unbiased recommendation.

G & F Products

Drop, Flat Hammer and Upset Forgings
Cut Gears
Speed Reducers
Rolling Mill Machinery
Special Machinery
Bridge Operating Mechanisms

GEARS AND FORGINGS, INC.
GENERAL OFFICES: 3016 WOODHILL ROAD, CLEVELAND, O., U. S. A.
District Offices: Chicago, Detroit, Buffalo, New York, Milwaukee, Indianapolis, Pittsburgh. *Factories:* Cleveland, Chicago, Ford City, Pa.

GEARS AND FORGINGS INC.
SPEED REDUCERS

TRADITION

"I'M finally convinced, Lad, that now is the time for us to start using arc welding.

I understand that welds produced by a shielded arc are welds that we can stand behind."

PROGRESS

"Right you are, Pop, if we use the Lincoln 'Fleetweld' process. It is the only manual process with a completely shielded arc that produces welds economically.

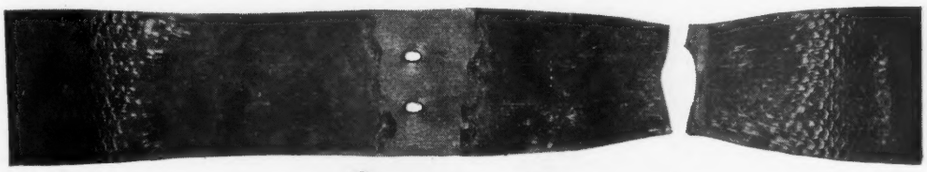
In this process the shielded arc precludes practically all possibility of oxides and nitrides forming in the weld metal. Consequently welds produced by the Lincoln 'Fleetweld' process have a tensile strength of 60,000 to 75,000 lbs. per square inch—10,000 to 20,000 lbs. stronger than mild rolled steel.

And these welds are ductile. When pulled they will show a 20% to 30% elongation in 2 inches.

Welding with the Lincoln 'Fleetweld' process costs less because you can weld two or three times faster with it than with any other manual welding method.

Of course in many cases where production warrants automatic welding, the Lincoln 'Electronic Tornado' process will produce the same quality welds with a shielded arc but more economically."

THE LINCOLN ELECTRIC COMPANY
Department No. 5-12 **Cleveland, Ohio**
World's Largest Manufacturers of Arc Welding Equipment



This test bar of steel plate welded by the Lincoln "Fleetweld" process broke when subjected to pull of 54,000 lbs. per square inch. The weld was machined flush with plate and two .182 in. diameter holes drilled through weld before testing. The stress imposed on the weld was 60,900 lbs. per square inch which stretched the holes to 17/64 in. diameter, an elongation of more than 40%.

Weld made by Lincoln "Fleetweld" process (shielded arc).

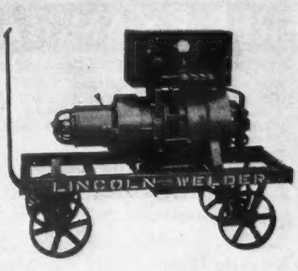
Weld made by ordinary arc welding method.

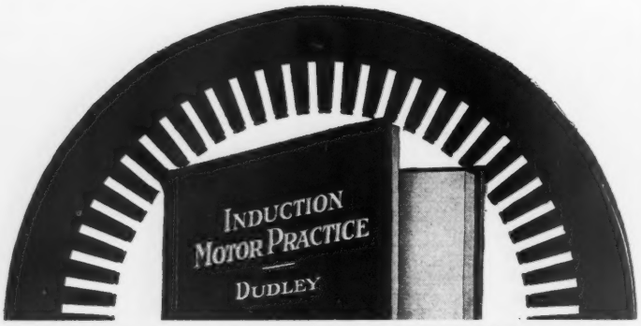
A simple test of the greater ductility of welds made by the Lincoln "Fleetweld" process. Both welds were made on a straight piece of steel plate which was then bent as shown.

W-159

LINCOLN "Stable-Arc" WELDER

Lincoln "Stable-Arc" welder, motor-driven portable truck type, for use where electric power is available.





FREE—if you order Now!

TO EVERY MAN who subscribes to the **Library of Electrical Maintenance and Repair** NOW we will give a copy of Dudley's Induction Motor Practice, the latest and most practical book on the subject. No charge for it—it comes to you FREE with this helpful maintenance and repair library.

Electrical Maintenance and Repair

5 volumes—1810 pages—1756 pictures and diagrams

This library contains the largest collection of practical methods for electrical repair and maintenance men ever put together in book form. Here you will find the best modern practice in repair work. The authors have drawn not only from their own extensive experience, but from the experience of electrical maintenance men in large and small repair shops and manufacturing plants throughout the country.

Every maintenance and repair man needs them

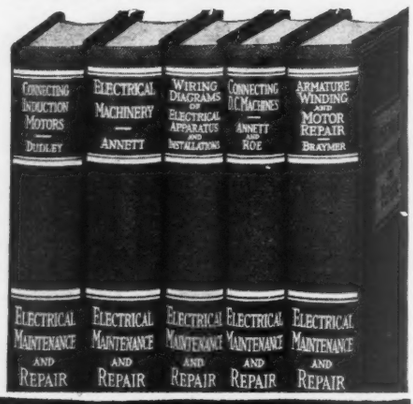
Every man concerned with the care and repair of electrical machinery should have these practical books. Every one of the five volumes is jammed to the covers with sound, how-to-do-it information—the kind you have to have when anything goes wrong.

The books contain hundreds of photographs, diagrams and tables, which show you how to go about it to make an effective repair job. There are wiring diagrams covering A.C. and D.C. generators, feeders, transformers, potential regulators, synchronous converters, batteries and boosters, substations, lamp mechanism connections, rheostats and controllers, lightning arresters, automobile switches, railway controllers, etc.

Free examination—no money down—small monthly payments—and a great book FREE!

Fill in and mail the coupon attached and we will send you the entire set of five volumes for ten days' Free Examination. We take all the risk—pay all charges.

You assume no obligation — you pay nothing unless you decide to keep the books. Then $1.00 in ten days and the balance at the rate of $2.00 a month. Upon receipt of your first payment we will send you a free copy of Dudley's Induction Motor Practice.


CONNECTING INDUCTION MOTORS — DUDLEY
ELECTRICAL MACHINERY — ANNETT
WIRING DIAGRAMS OF ELECTRICAL APPARATUS AND INSTALLATIONS
CONNECTING D.C. MACHINES — ANNETT AND ROE
ARMATURE WINDING AND MOTOR REPAIR — BRAYMER
ELECTRICAL MAINTENANCE AND REPAIR
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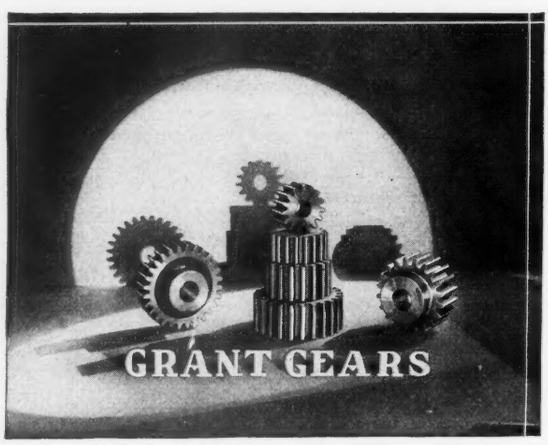

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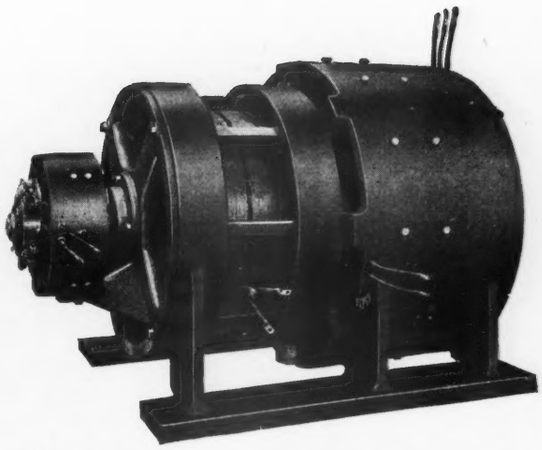

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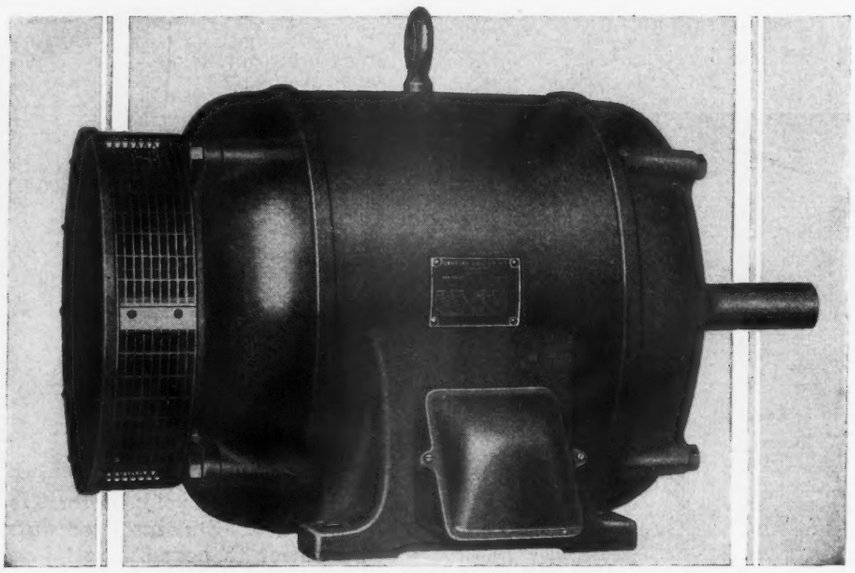

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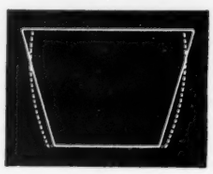


Fig. 1

The ordinary straight-sided belt is therefore forced to assume, in the sheave groove, the shape shown by the dotted lines in figure 1.

Two faults result: (1) The bulging causes uneven wear on the sides of the belt—*shorter life!* (2) The entire side of the belt does not uniformly grip the pulley—*a loss in drive efficiency.*

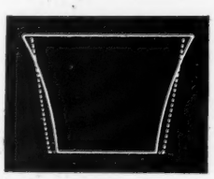
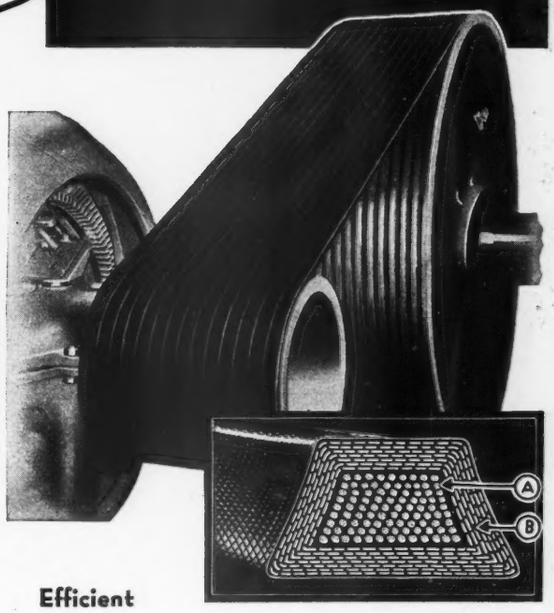


Fig. 2

Contrast the belt designed with the accurate concave side (patent pending) — the Gates Vulco Rope. As this belt bends, it assumes a shape that *exactly fits* the sheave groove. (Fig. 2). Two advantages: (1) Wear is evenly distributed over the entire side—*longer life!* (2) The whole side-width uniformly grips the pulley — *full delivery of power!*



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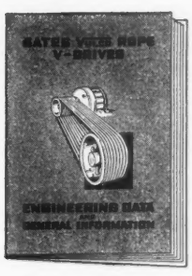

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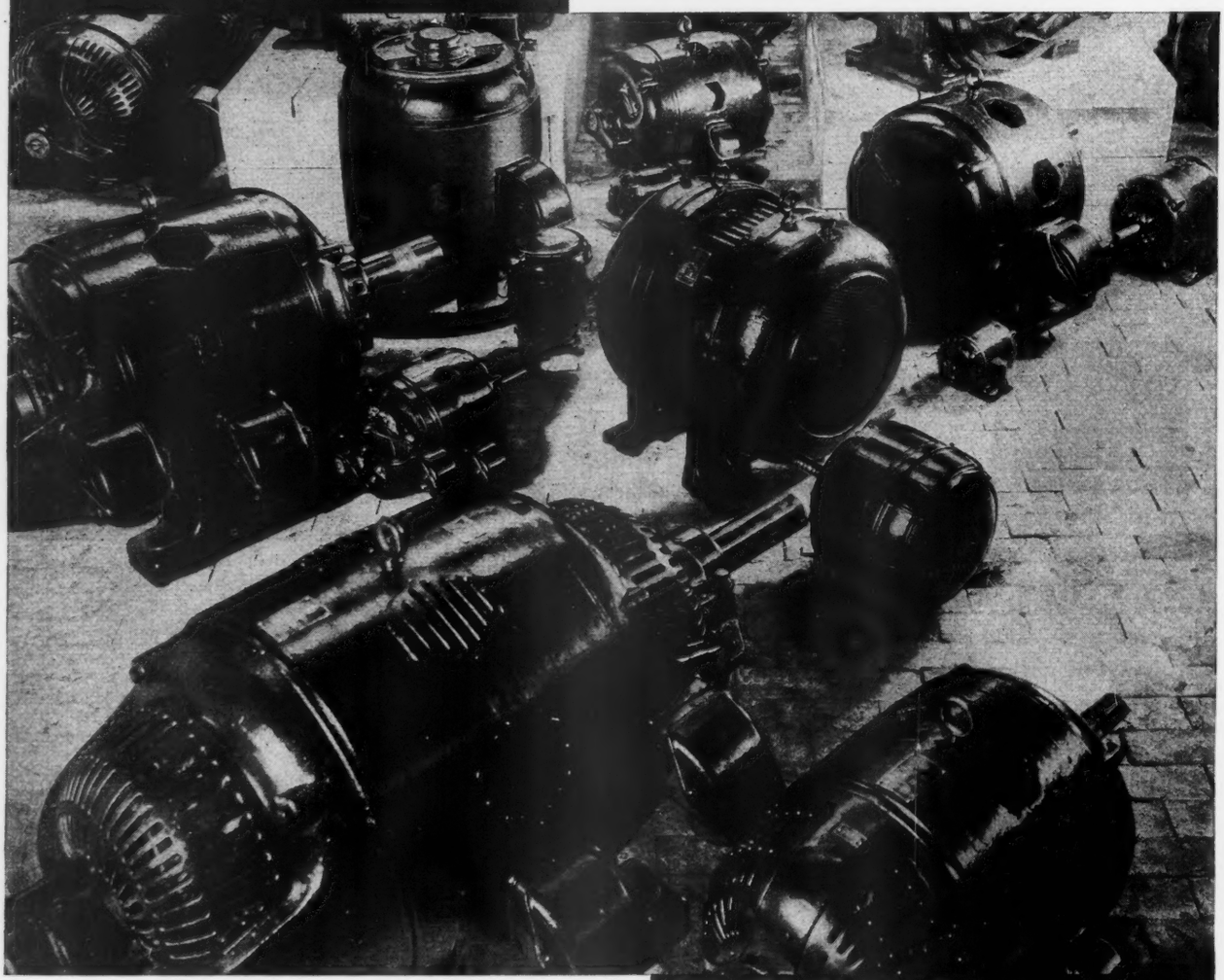

with resultant shutdowns and expensive repairs. » » » It is not a simple matter to select motors. Variation in type, horsepower, starting torque, pull-out torque, starting current, and other considerations are bewildering. Selection of the right motor is too important to entrust to anyone other than a recognized motor specialist. » » » The wide range of types and ratings of motors manufactured by Wagner (some 25,000 type-hp-rpm combinations) is an assurance that Wagner recommendations are made without prejudice, and that at no time will the wrong type of motor be supplied. When motors are under consideration, consult Wagner.

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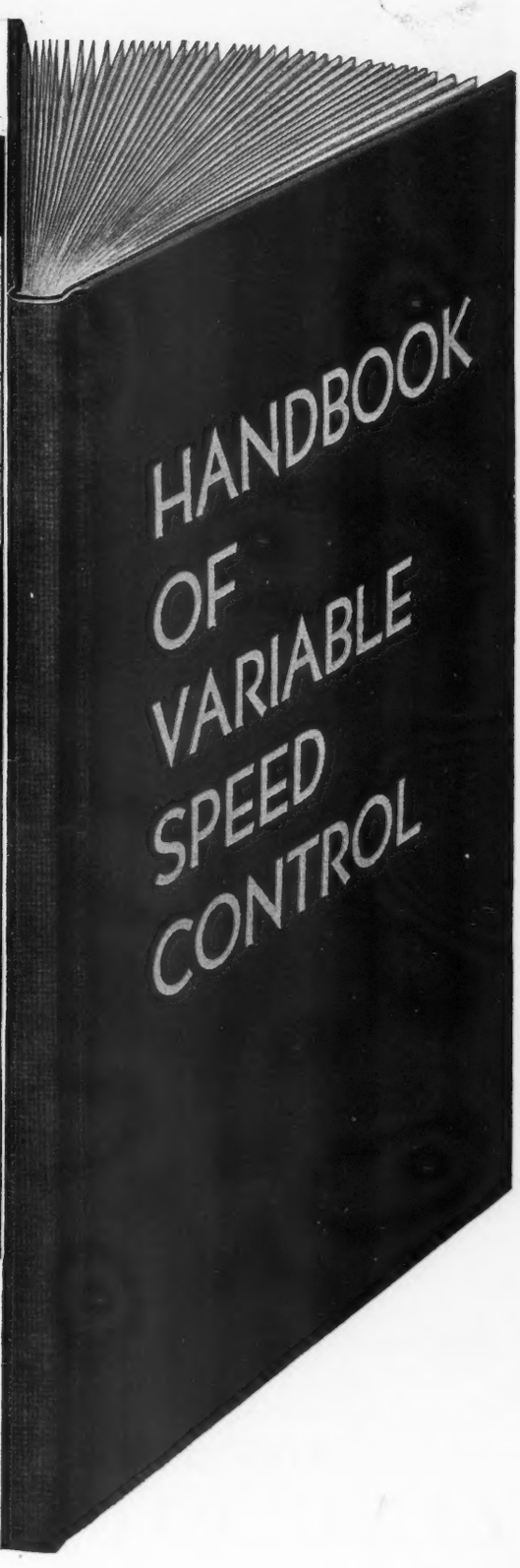

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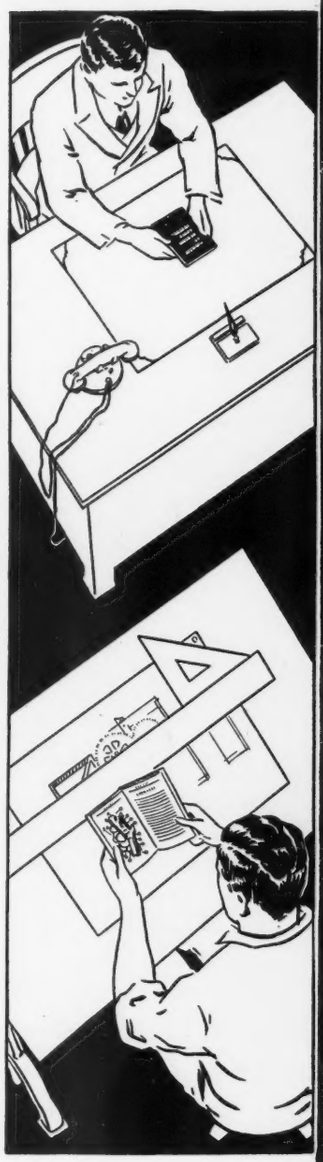

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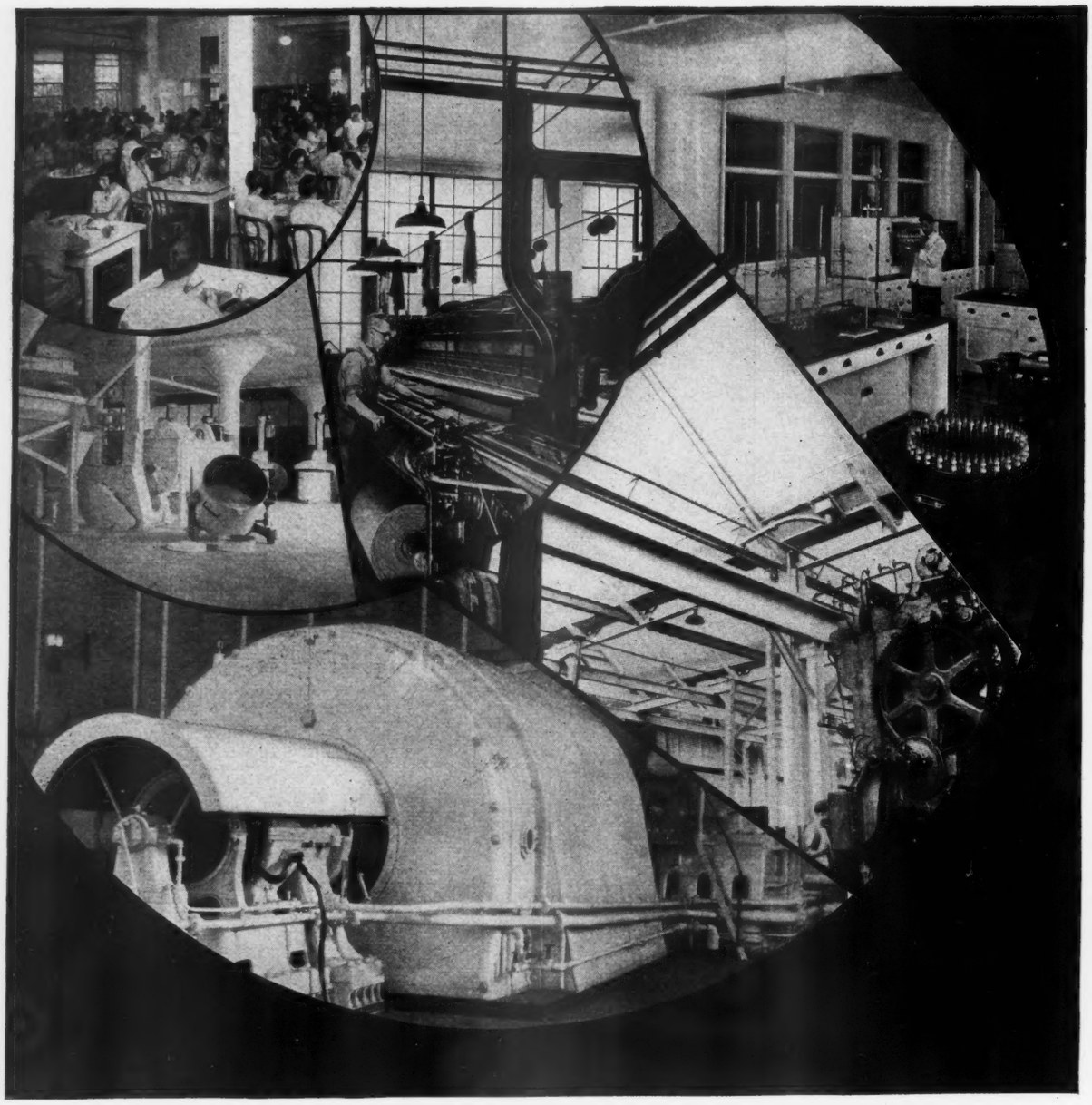

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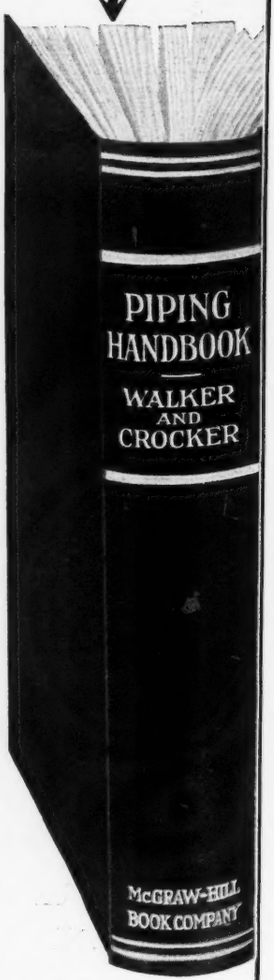

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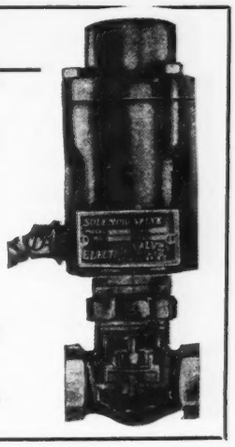

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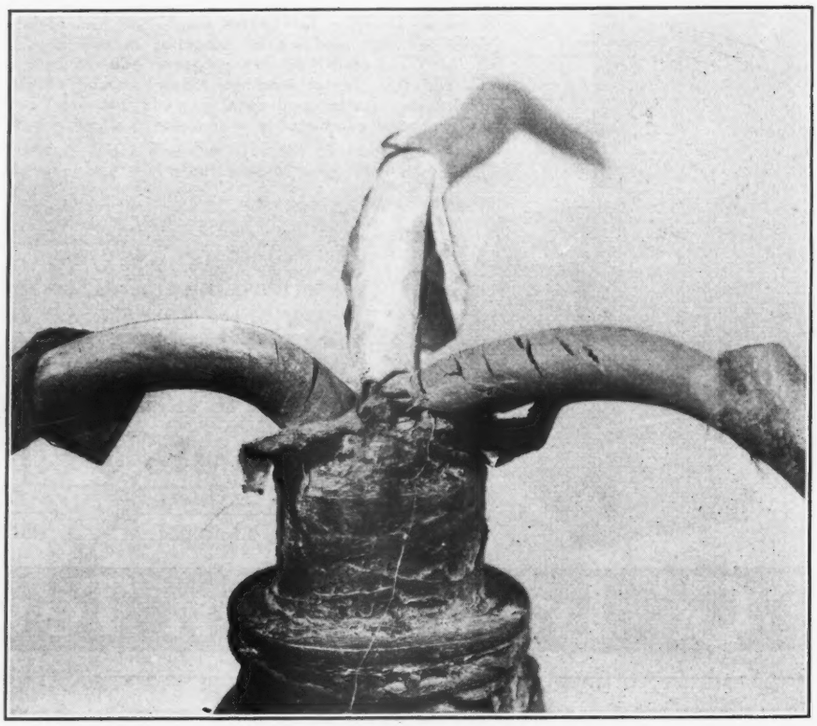

Voltage stress in air, either within or about a rubber insulated high voltage cable is likely to cause corona, the formation of ozone and damage to the insulation similar to that shown in the illustration.

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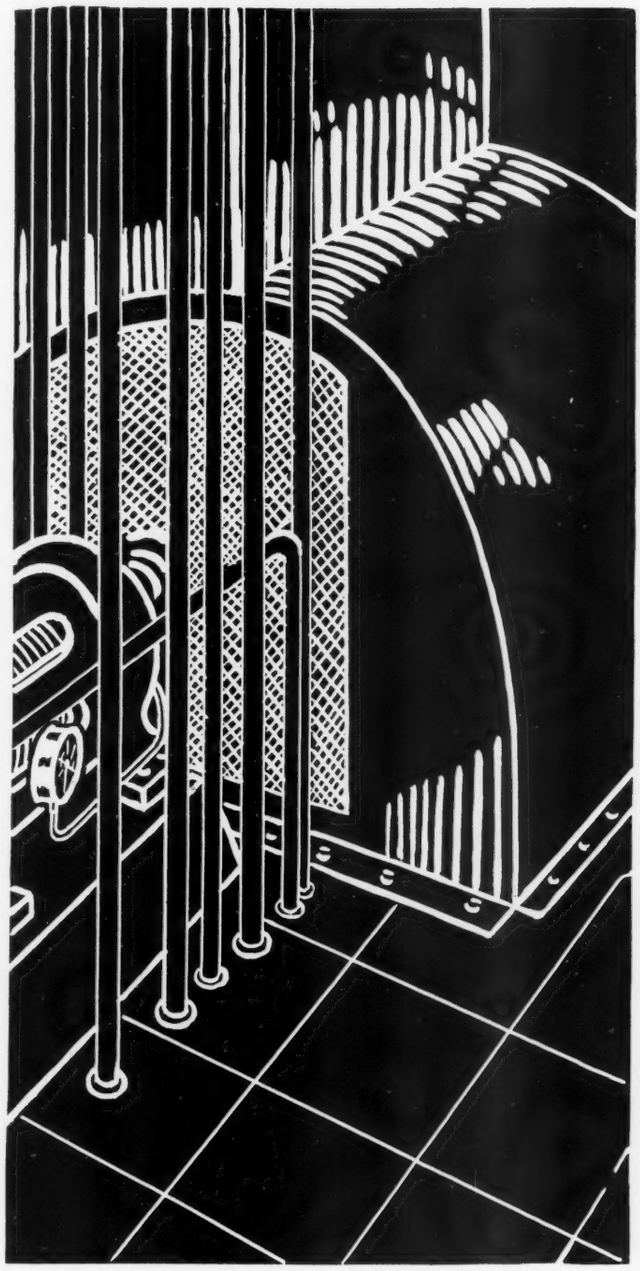

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A husky induction motor had its rear bearing within a foot of the intake screen on a large ventilating fan, over a high temperature drying room. It was hot up there—sometimes 110°. The draft had a habit of sucking oil out of the motor bearing. The bearing was completely surrounded by hot steam pipes and it was dark. A thermometer was issued and the attendant told to check that bearing temperature every fifteen minutes. Naturally, the bearing was neglected. One day it froze.

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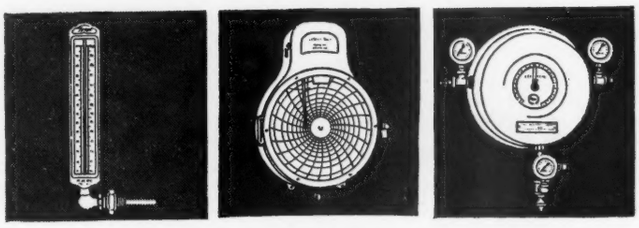

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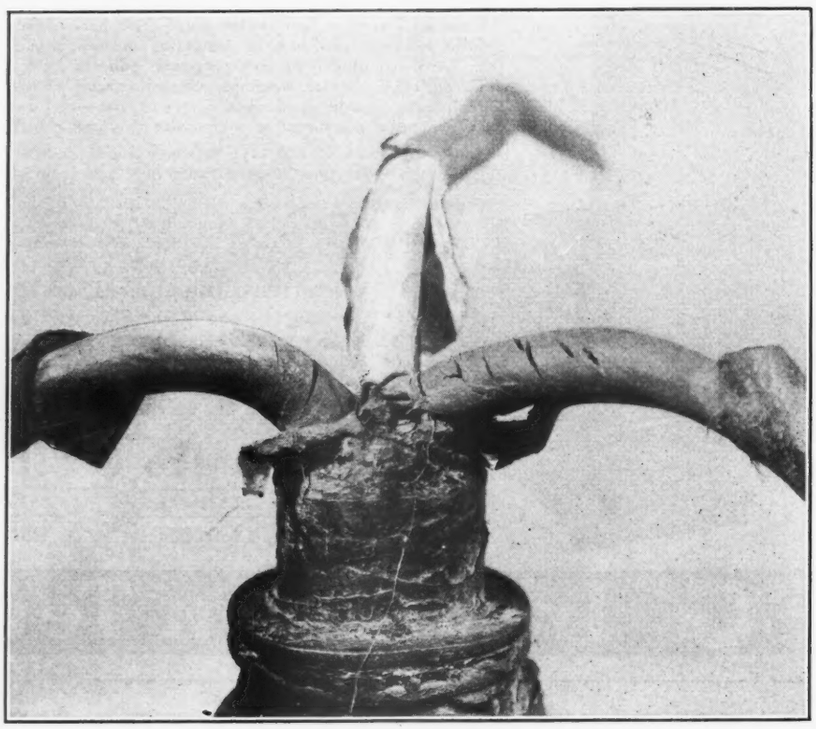

Voltage stress in air, either within or about a rubber insulated high voltage cable is likely to cause corona, the formation of ozone and damage to the insulation similar to that shown in the illustration.

Instead of trying to overcome the ozone hazard with metallic shields, protective coverings or so called ozone proof or ozone resisting insulation, we approached the problem from another angle and designed a new type of rubber insulation called "ANOROC" (corona from another angle) which prevents the formation of corona and ozone.

"ANOROC" rubber insulation positively prevents the formation of corona and ozone within or about a cable at normal operating voltage. It retains all of the qualities which identify a high grade rubber compound.

Further information and details of tests are contained in a recent Simplex publication entitled "Corona Prevention and Ozone Elimination." May we send a copy to you?

Patent applied for.

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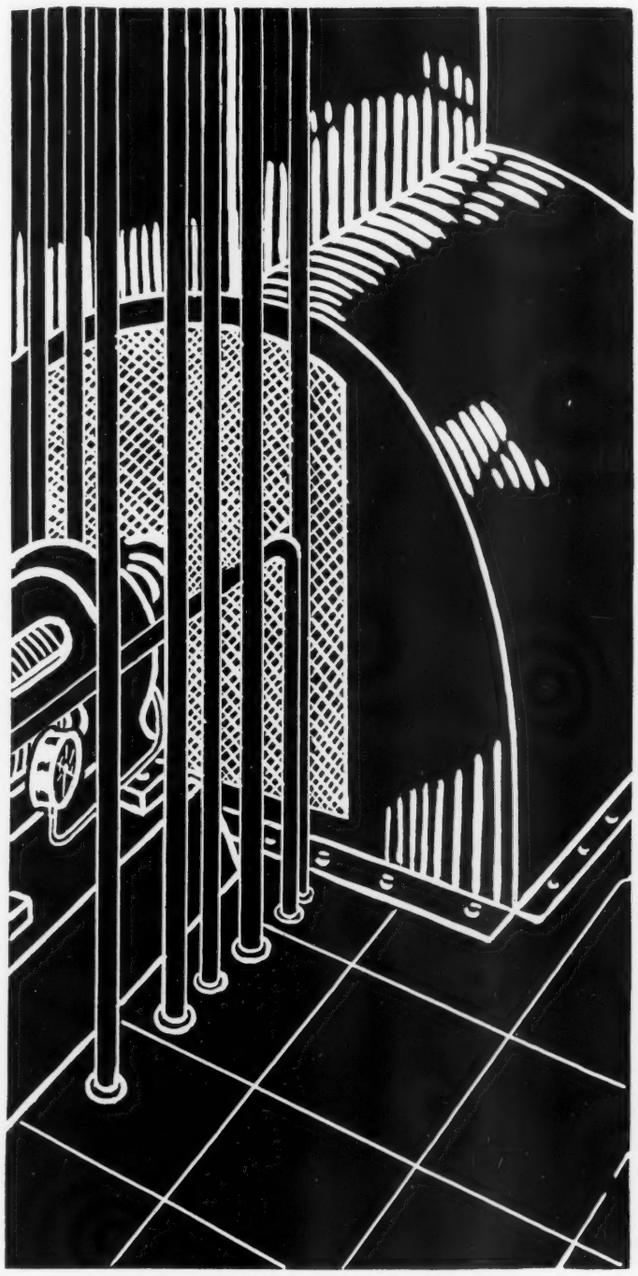
JACKSONVILLE, 417 Barnett National Bank Building

SIMPLEX INSULATED·WIRES AND CABLES



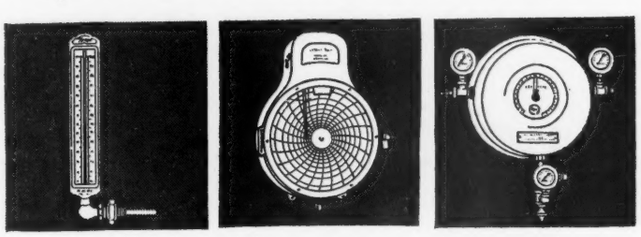
It's in the dark no longer!

A husky induction motor had its rear bearing within a foot of the intake screen on a large ventilating fan, over a high temperature drying room. It was hot up there—sometimes 110°. The draft had a habit of sucking oil out of the motor bearing. The bearing was completely surrounded by hot steam pipes and it was dark. A thermometer was issued and the attendant told to check that bearing temperature every fifteen minutes. Naturally, the bearing was neglected. One day it froze.

Well, they now have a clearly readable Tycos Recording Thermometer on that motor. The bearing gets its oil when it needs it. There is no more light there than before but the bearing condition is in the dark no longer.

Tycos Temperature and Pressure Instruments have a long history of dependable performance. Throughout the plant, no matter what the conditions, Tycos Instruments give a greater measure of satisfaction. We make them that way.

Tycos TEMPERATURE INSTRUMENTS



INDICATING RECORDING CONTROLLING

Taylor Instrument Companies

ROCHESTER, N. Y., U. S. A.

Canadian Plant, *Tycos* Building, Toronto, Canada

New York Chicago Boston Philadelphia Pittsburgh Cleveland Los Angeles Indianapolis San Francisco St. Louis Cincinnati Tulsa Detroit Atlanta Minneapolis

Manufacturing Distributors in Great Britain, Short & Mason, Ltd., London

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Sales Office: St. Louis, Indianapolis, Los Angeles, San Francisco, Seattle. In Canada: Canadian General Electric Co., Ltd.

Airplanes or Safety Switches

. . . they must be built to "carry their loads"

THE giant tri-motored monoplane for freight and passenger service, the small, easily maneuverable one-man biplane . . . each is designed and constructed for a particular duty.

So with safety switches. They must be chosen according to the load they are to carry. For severe service, where overloads are heavy and operation is frequent, select the Cutler-Hammer "Current Breaker," Bulletin 4101. Simple, sturdy, rugged, it has reserve enough to handle any emergency.

Handling 300% overloads with ease, the "Current Breaker" has interrupted a 600% overload, 21 times in rapid succession without breaking down. Quick *double* make and *double* break, heavy arc blankets, non-current-carrying hinges . . . these and other features make this switch the *only one of its kind.*

The Current Breaker, the C-H Industrial Duty "Type A" and the Standard Duty "Type C" Safety Switches are described in the C-H Catalog SS5. Send for a copy.

The C-H "Current Breaker" Bul. 4101-H14—3 pole —230 V.—60 Amp.

Enclosed view —Bul. 4101-H15—3 pole —230 V.—100 Amp.

CUTLER-HAMMER, Inc.
Pioneer Manufacturers of Electric Control Apparatus
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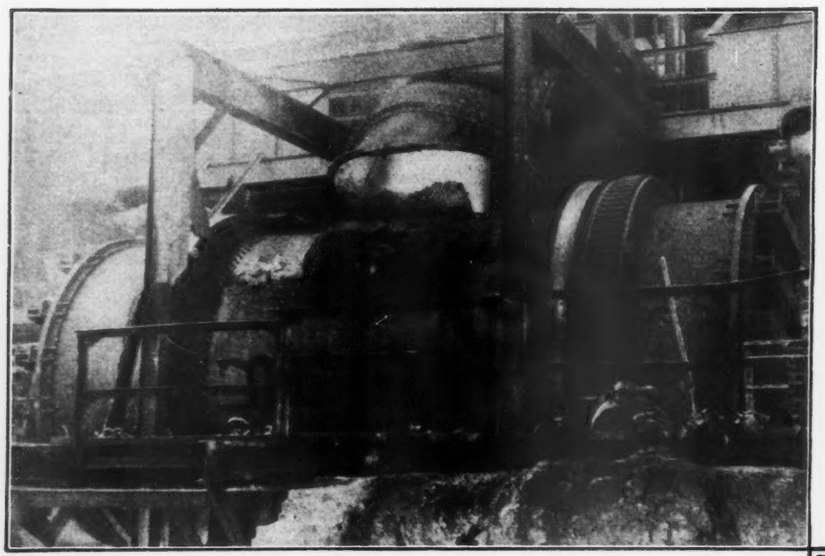
High Quality Safety Switches For Every Service

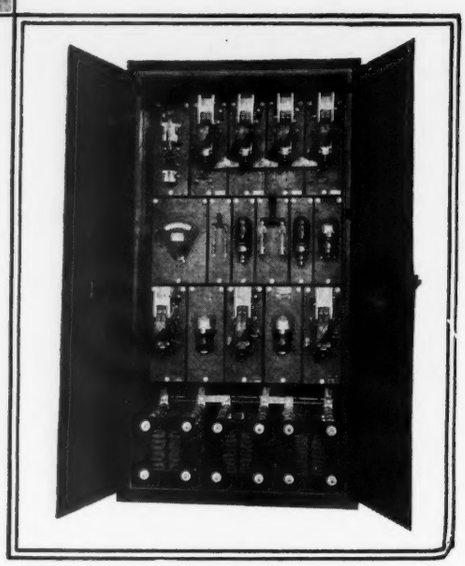
(A-370)

An Interesting Example of Control Engineering



Below—One of eight EC&M Time-Current Controllers used to control eight of these hot metal converters.

PROTECTED *against damage by power failure*— this Converter Control was engineered by EC&M



IF POWER fails while this converter is in operation, the air blast which blows thru the molten metal will also fail. If no precautions were taken to avoid this condition, the molten metal would immediately start flowing downward thru the air inlets or tuyeres, where it would solidify. The EC&M Magnetic Controller, illustrated at the right, guards against this condition.

Normally, this controller directs the operation of the converter from a manually operated master switch. The instant that power fails, however, the control is taken from the operator and the controller automatically directs the rotation of the huge cylinder by means of power supplied by the energy of the flywheel on the motor-generator set until the tuyeres are above the surface of the molten metal. Then a limit stop cuts off the motors.

Protection against failure of the air blast is also accomplished in the same manner. If the blast fails or the pressure falls below a predetermined value, the control is taken from the operator and the converter immediately returned to the "safe" position.

This is only one of the many examples of EC&M Control Engineering. Our nearest branch office will be glad to tell you more about this service. Write them about your next control problem.

THE ELECTRIC CONTROLLER & MFG. CO.

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Motors fail on the job because coils burn out, due to severe service and overloads.

Exterior conditions in which motors operate, such as gases, fumes, extreme heat, acids, etc., raise havoc with the windings and leads of motors.

Failure due to these causes can be eliminated. Carbonized motor windings can be avoided.

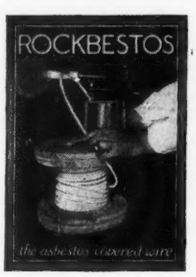
Insist that the motor coils be wound with a magnet wire that is especially built for this purpose, and is unaffected by any of these conditions. It is just as important that the leads and internal connections of motors be of cable equally unaffected by the same conditions.

ROCKBESTOS Magnet Wire for coils, and Cables for leads and internal connections keep the motor on the job, cut down replacement costs and add to the life of the motor.

Maintenance departments of industrial plants will add to production facilities, if they will insist on using these ROCKBESTOS Wires and Cables for their motors.

For motors using Magnet Wire 15 to 30 B & S gauge, we can supply an asbestos insulated wire with uniform diameter, no greater than cotton covered.

Samples of our magnet wire and motor leads will be gladly sent. Just send the coupon below.



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FROM outward appearances and judging from claims of competing tire salesmen, all truck tires are about the same except in price. But performance tells a different story and careful buyers purchase only on proven performance.

The electric wiring for lighting and power in a factory should be purchased on the same basis. Its insulation is rubber and rubber compounds vary widely in performance. Some deteriorate rapidly from age alone. Heat, vibration and high voltages hasten this decomposition. The effects are not apparent until a failure occurs which may cripple important production units and completely cripple a manufacturing schedule.

OKONITE insulated wires and cables are dependable. For over half a century they have established a proven reputation for top quality and their performance under all conditions of use is a standard of value for all careful buyers.

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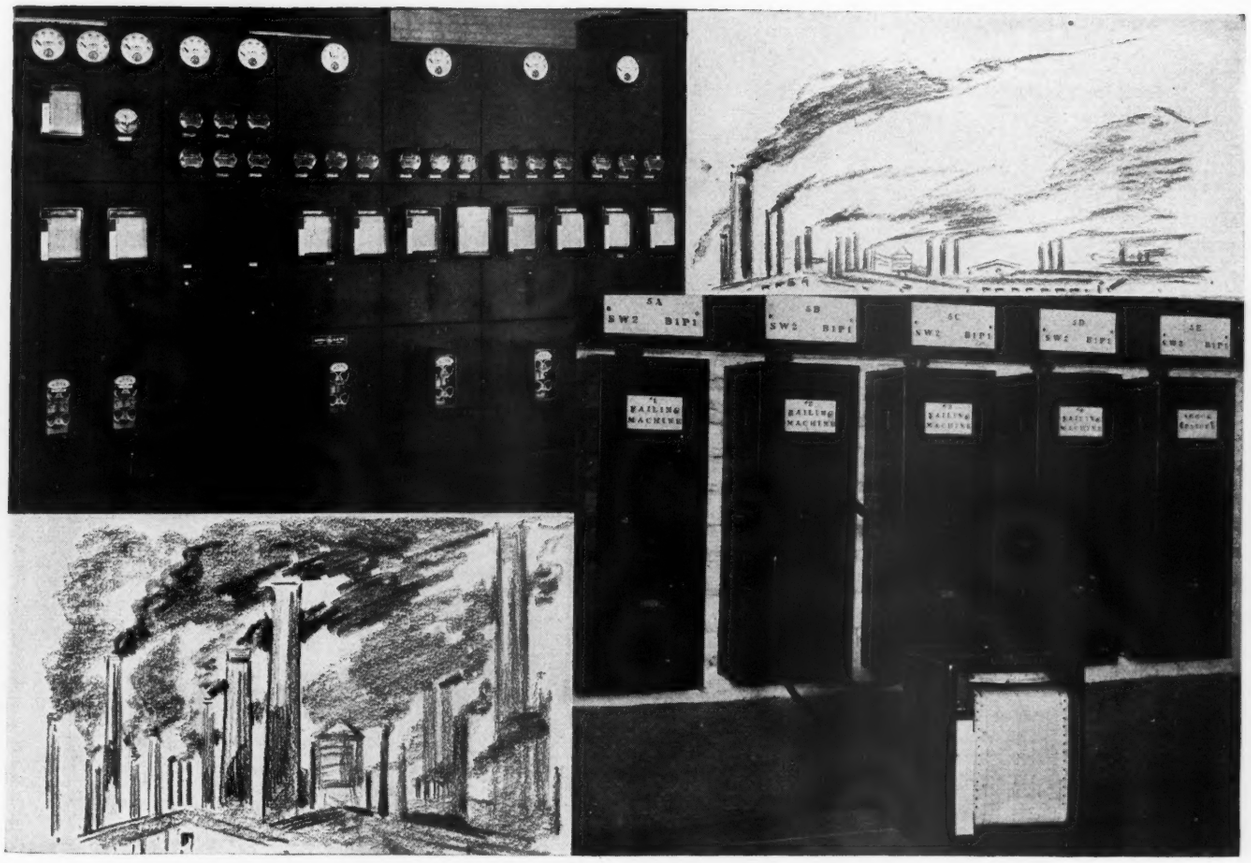
OKONITE QUALITY CANNOT BE WRITTEN INTO A SPECIFICATION



Upper picture shows a switchboard installation of eleven Esterline-Angus Graphic Meters in one of the country's largest storage battery plants. The lower illustration shows an Esterline-Angus Portable type meter in use in the same plant.

Whether You Make BATTERIES OR BATHTUBS— WASHING MACHINES OR WALL BOARD ...ESTERLINE-ANGUS METERS *are a Profitable Investment*

IN almost *any* manufacturing plant there are many opportunities for the *profitable* use of Esterline-Angus Graphic Recording Instruments.

The illustrations at the top of this page were made from photographs taken in the plant of one of the country's largest manufacturers of storage batteries. But these instruments *can* be used just as advantageously in almost any other large manufacturing establishment.

To make a permanent record of power produced, purchased or consumed; to locate faulty equipment and to determine the capacity of new units which may be profitably installed; to watch production and productive labor; to check demand and energy charges and regulate power factor; to assist in maintaining the quality of products to an established standard. In all of these ways—and many more—Esterline-Angus Graphic Meters pay their own way, and a profit besides.

Perhaps we may have data describing the uses of these instruments in *your* industry. No obligation is involved in a request for further information.

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Matchless Value

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The answers are... (1) Over 60 years of experience; (2) Sturtevant Engineering and Research Facilities; (3) Quantity Production!

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1—500 kw., 250 v., Westinghouse Synchronous
1—300 kw., 125 v., 3 wire, 3 unit, Ridgeway.
1—500 kw., 250 v., Westinghouse Synchronous motor Generator Set.
1—250 kw., 230 v., 3 ph., 60 cy., 2300-4600 v. Synchronous Motor Generator Set.
1—200 kw., 230 v., 3 ph., 60 cy., 2300-4100 v. Synchronous Motor Generator Set.
1—150 kw., 600 r.p.m., 250 v., Gen., 3 ph., 60 cy., 220-440 v., G.E. Synchronous motor.
1—125 kw., 250 v., Westinghouse Synchronous Gen. Motor Set, 3 ph., 60 cy., 230-2200 v.
1—100 kw., 125 v., D.C., 220-440 A.C. G.E. Synchronous Motor Generator Set, 220-440 v.
1—100 kw., 250 v., Gen., 900 r.p.m., 2200 Synchronous Motor.

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1—75 kva., 3 ph., 60 cy., Westinghouse Geared Non-Condensing Turbine.

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1—1500/3000 kva., G.E., combined oil and water cooled 3 ph., 60 cy., 11000-22000-2300 v.
3—50 kva., G.E., 13000/26000—220/40.

A.C. GENERATORS

No.	Kw.	R.p.m.	Volts	Ph.	Type
1	400	900	2300–4000	3	Westg.
1	350	600	440	3	Westg.
2	125	900	2300	3	Cr.-Wh.
2	100	900	230–2300	3	G.E.
1	75	600	220	3	Westg.
1	75	900	2300	3	G.E.
1	50	1200	220–440–2300	3	G.E.

MOTORS—3 Phase, 60 Cycle

No.	Hp.	R.p.m.	Volts	Type
1	500	900	440/4000	Westinghouse Syn.
1	500	900	440–2200	G.E. Syn.
1	350	900	2200/4000	Wh. syn.
2	300	600	445–2600	G.E. syn.
1	250	600	2200/4000	G.E. syn.
1	250	600	220–440	Westg. syn.
1	250	600	440–2200	G.E. syn.
3	200	514	4150–2300	G.E. syn.
2	175	3 ph.	60-cy.	2300 volts, G.E.
4	150	1200	220/440	Westg. sl. ring.
1	150	900	2300	G.E. syn.
2	150	514	2200	Westg. sl. ring.
1	150	1800	2200	West. sq. cg. mfr.
1	100	900	440–2200	G.E. sq. cg.
1	100	900	220–440–220	Westg. sq. cg.

D.C. GENERATORS

No.	Kw.	R.p.m.	Volts	Type
1	200	900	250	G.E.
1	200	600	250	G.E.
1	200	525	250	G.E.
2	150	1200	250	Cr.-Wheeler
1	150	600	250	G.E.
2	150	1200	250	Westg., new
1	100	720	250	G.E.
1	75	450	250	Diehl.

(Smaller Sizes on Request)

D.C. MOTORS—230 VOLT

No.	Hp.	R.p.m.	Type
1	250	550	G.E.
2	200	1150	Cr.-Wheeler
1	150	600	G.E.
3	150	850	Westg. SK., new
1	150	1100	Westg. SK.
1	125	550	Cr.-Wheeler.
1	100	625	Westg. Type S.

(Smaller Sizes on Request)

D.C. MOTORS—125 VOLT

No.	Hp.	R.p.m.	Type
1	125	575	G.E.
1	100	600	G.E.
1	80	600	G.E.

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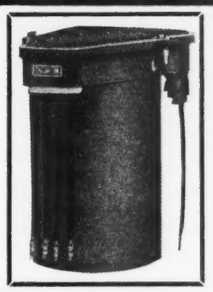

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CHIEF Electrician or Sales Engineer. 25 years' experience all around electrical construction and maintenance. Industrial plant and sub-station installation. 15 years in charge of steel mill 9,000 H. P. 100% electric drive. Broad knowledge plant and system economics. Power factor correction. Power surveys. Knowledge of power contracts. A-1 references. PW-364, Industrial Engineering, 520 No. Michigan Ave., Chicago, Ill.

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Dept. C., Ft. Wayne, Ind.

CHICAGO REPRESENTATIVE

Manufacturing Agent, Electrical Engineer; experienced merchandiser; motors, control, transmission; would communicate with manufacturer. Address, R. A. 501, Industrial Engineering, 520 N. Michigan Ave., Chicago. Ill.

SLIP-RING MOTORS—3 Ph., 60 Cy.

Hp.	Volts	Make	Speed
500	2200	G.E.	900
350	2200–440–220	G.E.	720
220	220–440	G.E.	450
200	2200–440–220	G.E.	600
150	220–440	G.E.	720
150	220–440	Westghse.	1200
150	220–440–550	G.E.	600
100	2200	Westghse.	900
100	550	G.E.	720
100	440–220	Allis-Chal.	900
100	440–220	G.E.	720
100	440–220	G.E.	900

DIRECT CURRENT MOTORS

Hp.	Volts	Speed	Make	Type
100	230	1150	G.E.	LC
50	600	1450	Westghse.	SK
50	230	1050	G.E.	RC
50	115	565	G.E.	DLC
40	230	750	G.E.	RC
35	230	850	Westghse.	SK

DIRECT CURRENT GENERATORS

Kw.	Volts	Speed	Make	Type
90	250	1150	G.E.	RC
50	125	725	G.E.	DLC
40	250	850	G.E.	RC
35	250	1050	Westghse.	SK

MOTOR GENERATOR SETS AND ROTARY CONVERTERS

1—165-kw., 125-250-v., 6-ph., 60-cy., 1200-r.p.m., G.E., with 2300-4000-v., 3-ph., transformer.
1—125-kw., 125-v., 1200-r.p.m., G.E., MPC, connected to ATL 440-220-v., 3-ph., 60-cy., syn. motor.
1—100-kw., 250-v., 3-ph., 60-cy., 1200-r.p.m., Westinghouse, with 2300-v. transformer.
1—65-kw., 250-v., 1200-r.p.m., G.E., R.C. connected to KT. 440-220-v., 60-cy., squirrel cage motor.

A.C. GENERATORS

1—250-kva., 200-r.p.m., 2200-440v., G.E.
1—187-kva., 720-r.p.m., 2200-440-220-v., G.E.
1—120-kva., 900-r.p.m., 2300-4000-v., G.E.
1—112½-k.v.a., 900-r.p.m., 2200-240-480-v., G.E.
1—75-kva., 1200-r.p.m., 2200-480-240-v., G. E.
1—62½-kva., 1200-r.p.m., 240-480-v., Westinghouse.
1—56-kva., 1200-r.p.m., 240-480-v., G.E.
1—50-kva., 1200-r.p.m., 2300-480-240-v., G.E.

STEPHEN HALL & CO., INC.

693 Adams St., Hoboken, N. J.

Index of Advertisers

Adam Electric Co., Frank..... 41
Ahlberg Bearing Co..... 8
Alemite Corp. 51
Allen-Bradley Co. .....4th Cover
Allis-Chalmers Mfg. Co.....2nd Cover
Aluminum Co. of America..... 29
American Fixture Co..... 52
American Pulley Co., The..... 19
Anti-Hydro Waterproofing Co..... 68
Appleton Electric Co..... 43

Baylis Co., The..... 40
Biddle, James G..... 69
Bull Dog Electric Products Co..... 54
Burke Electric Co..... 61
Bussmann Mfg. Co..... 20
Byers Co., A. M..... 7

Century Electric Co..... 62
Cities Service Oil Co.....10-11
Clark Controller Co., The..... 45
Clark Tructractor Co..... 40
Cleveland Worm & Gear Co..... 27
Cling Surface Co..... 41
Colt's Patent Fire Arms Mfg. Co..... 6
Continental Diamond Fibre Co..... 32
Cutler-Hammer, Inc. 14, 73

Dayton Rubber Mfg. Co..... 31
DeLaval Steam Turbine Co..... 46
Delta-Star Electric Co..... 53
Dixon Crucible Co., Joseph.....55, 61

Electric Controller & Mfg. Co., The.... 74
Electric Storage Battery Co., The..... 24
Electric Valve Mfg. Co..... 69
Esterline-Angus Co., The..... 77

Fabreeka Belting Co..... 13
Foote Bros. Gear & Machine Co..... 25

Gates Rubber Co..... 63
Gears & Forgings, Inc..... 58
General Cable Co..... 44
General Electric Co..... 16
Gilmer Co., L. H..... 56
Grant Gear Works..... 60

Hitchcock Co., The..... 53
Houghton & Co., E. F..... 47

Irvington Varnish & Insulator Co..... 17
I-T-E Circuit Breaker Co.....3rd Cover

James Mfg. Co., D. O..... 21
Jeffrey Mfg. Co., The..... 15

Leland Electric Co..... 41
Lincoln Electric Co., The..... 59
Link-Belt Co. 5

McGraw-Hill Book Co.....40, 60, 68
Mica Insulator Co..... 48
Monitor Controller Co..... 39
Mutual Foundry & Machine Co..... 46

National Carbon Co., Inc..... 37
National Vulcanized Fibre Co..... 53
New Jersey Zinc Co., The..... 66
Norma Hoffmann Bearings Corp..... 12

Okonite Co., The..... 76

Philadelphia Gear Works..... 36
Pure Oil Co., The..... 67

Reeves Pulley Co..... 65
Reliance Electric & Engineering Co.... 57
Republic Rubber Co..... 22
Rivett Lathe & Grinder Corp..... 60
Rockbestos Products Corp..... 75
Rockwood Mfg. Co..... 28
Roebling & Sons Co., The John A....49-50
Roller-Smith Co. 46

Schwenk Safety Device Corp..... 52
Shepard Niles Crane & Hoist Corp..... 23
Simplex Wire & Cable Co..... 70
Smith Power Transmission Co., The.... 52
Square D Co..... 82
Stanlard Oil Co. (Indiana)..... 18
Standard Pressed Steel Co..... 26
Steel & Tubes, Inc..... 42
Steelcity Furnace Co..... 52
Sticht & Co., Herman H..... 81
Sturtevant Co., B. F..... 78

Taylor Instrument Companies..... 71
Thompson Electric Co., The..... 47
Timken Roller Bearing Co., The..... 34
Tool Steel Gear & Pinion Co., The.... 30
Trumbull Electric Mfg. Co., The..... 4

Wagner Electric Corp..... 64
Westinghouse Electric & Mfg. Co..... 33
Westinghouse Lamp Co..... 38
Weston Electrical Instrument Corp..... 35
Wheeler Reflector Co..... 72
Wiegand Co., Edwin L..... 9

SEARCHLIGHT SECTION

Classified Advertising

Employment 79
Equipment, New and Rebuilt..... 79
Electric Service Co., Inc..... 79
Fuerst-Friedman Co. 79
Gregory Electric Co..... 79
Hall & Co., Inc., Stephen..... 79
Hemphill & Co., Inc., J. L..... 79
Land, L. J..... 79

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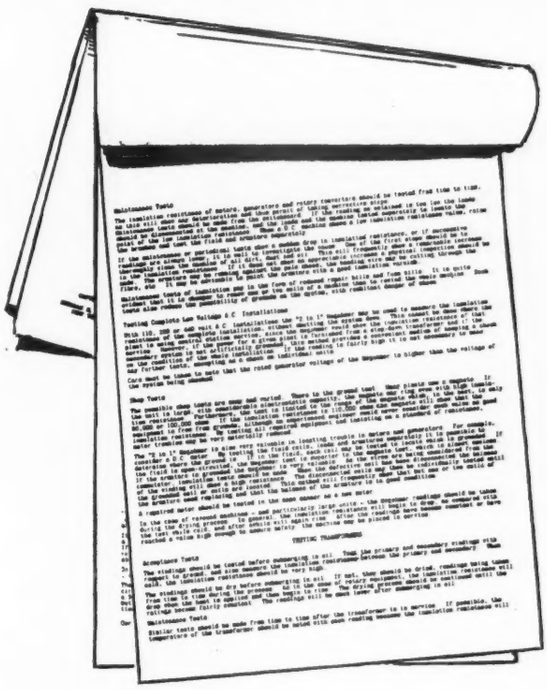

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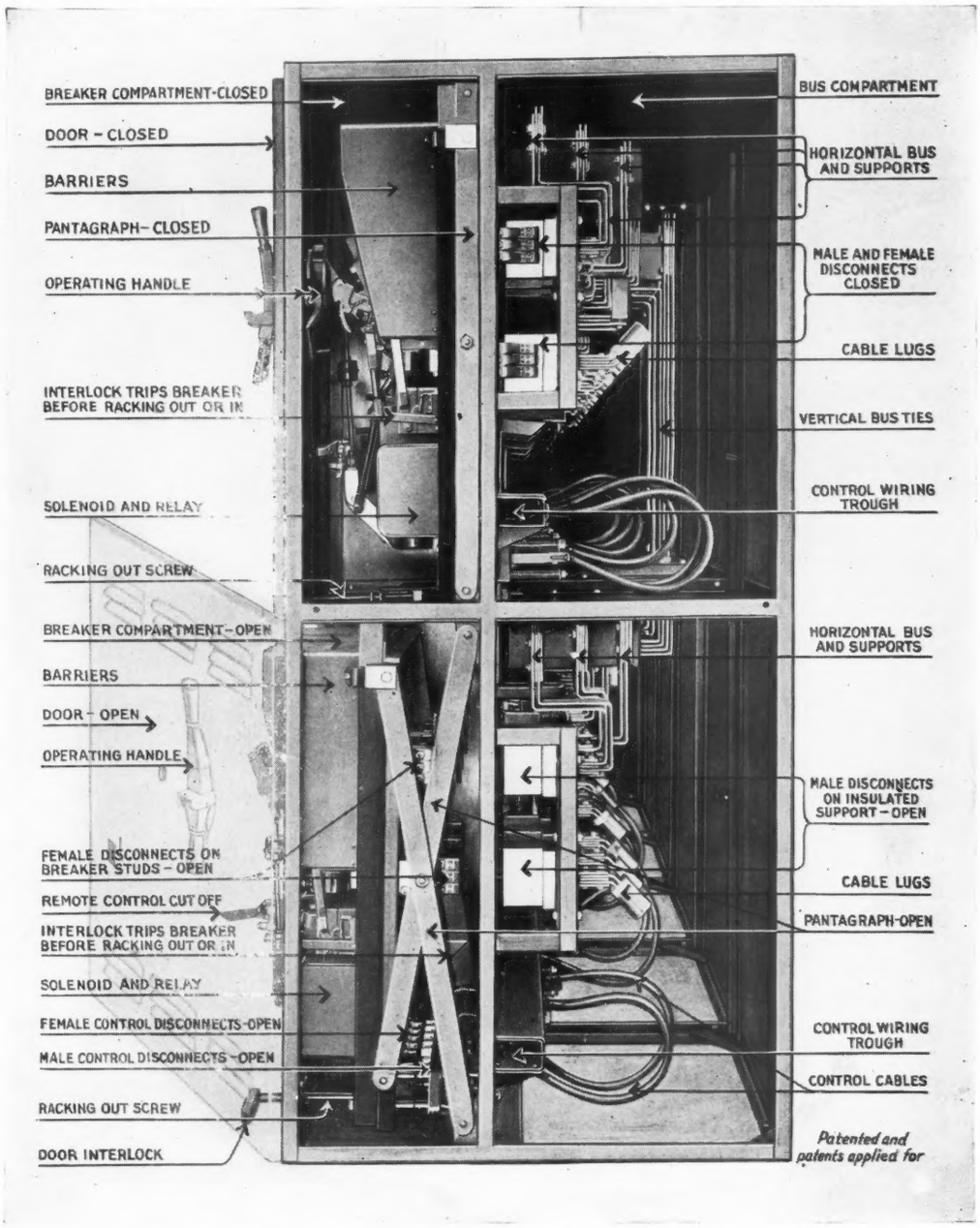
192

The Inside Story of the Multumite

"The World's Largest Builders of Air-Type Circuit Breakers"



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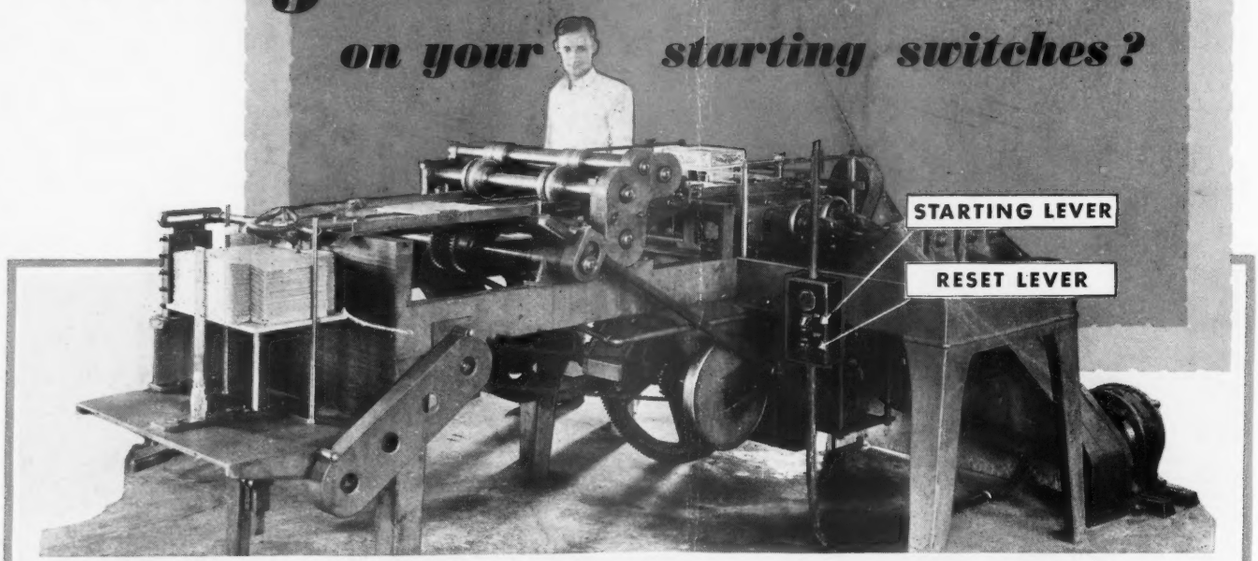
on your starting switches?



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The world has been waiting for a hand operated A. C. starting switch which would put an end to fuses and thermal plug delays.

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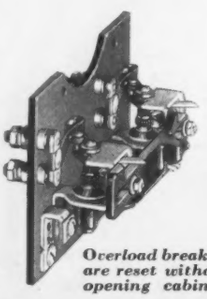

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